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**CHOICE OF EXCHANGE RATE REGIME IN THE
PRESENCE OF COMMODITY PRICE DISTURBANCES**

by

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Degree: **PHD**



**UNIVERSITY OF WARWICK
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Abstract

This thesis discusses the choice of an exchange rate regime for a small commodity-exporting economy which experiences both monetary shocks and commodity price shocks.

To investigate these matters, stochastic calculus is used in a continuous-time setting. The Franc Zone serves as an illustration: it is a currency union between a small country and a large country, and was subject to enormous strains in the last decade.

The model developed in chapters 3 and 4 stresses the role of expectations in affecting domestic price variability, when the commodity price is described as a Poisson process. It also points to an exchange rate policy of "leaning with the wind" on the basis of the price stability criterion. Chapter 4 further investigates how the degree of openness of the small economy can influence the choice of the optimal exchange rate.

Finally the analysis explains why the recent devaluation in the Franc Zone was a necessity in contrast to other studies which failed to notice the need for a devaluation. In this respect, it suggests a way to measure the degree of overvaluation.

Introduction

To judge from the diversity of arrangements one observes around the world, the choice of an exchange rate regime continues to be an issue today, three decades after the Bretton Woods system of pegged but adjustable exchange rates ended in 1973. These exchange rate regimes range from the free float generally adopted by the industrial countries and a few developing countries to the fixed exchange rate regime that a number of developing countries still have. Over time, intermediate exchange rate regimes have increased in importance as more and more developing countries have shifted from a single currency peg to a basket peg or other forms of managed float.

With the experiment of the EMS/ERM in Europe, the issue of currency union has drawn more and more attention. In this category of currency regime, the Franc Zone, which links some African countries and France, is a long-existing example. In the recent period, the Franc Zone has attracted more interest than ever before: it has experienced economic difficulties in the last decade in contrast to a relative success in the decade before, and this has led to the first ever devaluation in the Zone.

The present thesis addresses the issue of choosing an optimal exchange rate regime in a model of a small commodity-exporting economy. The representation adopted would fit to most developing countries (and the African countries of the Franc Zone in particular) since their export revenues depend heavily on one or two (primary) commodities. The model considers two types of disturbances which affect the small economy. The first is a terms

of trade shock, highly characteristic of a commodity-exporting economy. A second shock is an internal (monetary) disturbance, characteristic of many developing countries.

The thesis consists of six chapters. Chapter 1 gives a portrait of the Franc Zone. Included is a brief historical overview, the link between the African side of the Zone and France, the functioning of the system for the African countries, the experience over the last twenty years and the challenges that the management of such a currency union raises.

Chapter 2 provides a survey of the literature on exchange rate economics, (especially in preparation of the next two chapters). Given the large volume of literature on exchange regimes, a selection appears necessary with emphasis on: currency areas, optimal peg including the papers more directed at the Franc Zone case, and target zones.

Chapter 3 sets up the basic model for choosing an exchange rate regime in the context of a small commodity-exporting economy. We assume that the commodity price on the world market follows a Poisson process while the monetary shocks follow a Brownian motion process. Stochastic calculus in continuous time is applied in this and later chapters. The model brings about the policy implications for the small economy on the basis of a price stability criterion and enables a comparison of different types of exchange rate regimes.

Chapter 4 extends the model designed in the previous chapter. It gives a presentation of a two goods (tradable and non-tradable) economy, the tradable sector includes the export and import sectors. The small open economy continues to face two

types of shocks. Both are assumed to follow Brownian motion processes, although subsequently at the second stage, the commodity price is described as a Poisson process. The relative size of the two shocks matters as does the degree of openness of the small economy.

Chapter 5 deals with the issue of the Commodity Stabilization Funds which exist in most commodity-exporting countries. We use a model of intertemporal optimization in a stochastic environment. The aim of this chapter is two-fold. Firstly, there is the need to establish the economic rationale for these Funds. Secondly, we need to examine the extent to which the scheme of a Stabilization Fund might provide a satisfactory alternative to a flexible exchange rate regime. This question can be raised in the context of the African Franc Zone countries which have a fixed exchange rate regime.

The last chapter 6 focuses on recent events in the Franc Zone, namely the first ever devaluation of the CFA Franc (i.e. the currency in circulation in the African countries of the Zone and pegged to the French Franc). Drawing in part from the results of chapter 4, it explains how the indicators used by other studies failed to reveal the overvaluation problem and proposes a more appropriate indicator.

Chapter 1: Salient features of the Franc Zone

Introduction

The Franc Zone (FZ) is an interesting case of currency union. First the FZ is historically ancient, originating from the colonial period and second it involves a certain number of countries, precisely thirteen African countries and France. This long existence and the extent of the area coverage give potential significance to the Zone. It has to be said that it is a union between areas of very different economic power. The FZ is essentially a currency union between a small economy consisting of the African side and a large economy which is France.

Section 1.1 takes this small/large country portrait as the way the most appropriate to display the main characteristics of the Zone in economic terms.

Section 1.2 discusses in more detail the organisation and the functioning within the Zone. Finally section 1.3 looks at the enormous strains to which the FZ has been subject to in the last decade. The strains which include the sharp fluctuations in commodity prices, gyrations in G7 exchange rates and Libor proved too great for the fixed rate 50:1 (peg of the small economy currency to the French Franc) and led recently to the first ever devaluation of 50% in January 1994.

1.1 The FZ as an union between a small and large country

Although the FZ has only taken its present form since 1960, it

has its origins in postwar currency arrangements set in 1948. One can distinguish three different periods which most significantly have laid down milestones in the evolution of the Zone until the 1994 devaluation . The first period might be dated back to soon after the second world war. At that time, the African colonies of France were using the currency called CFA ("Colonies Francaises d'Afrique") and in 1948, the rate of 1 FF = 50 CFA was established between the French currency and that of its colonies in Sub-Sahara. At that time also, there was no Central Bank as such for these colonies and this role was played by a private bank, the BAO ("Banque de l'Afrique Occidentale").

What happened next will prove to have determined the main features of the FZ. For in 1960, came the independencies of the ex-colonies. As a direct consequence they had got also the right to print money. But this was organised through two Central Banks: one for the group of countries in the western African region, known as BCEAO ("Banque Centrale des Etats de l'Afrique de l'Ouest"), and another for the group of countries in the central African region called BEAC ("Banque des Etats de l'Afrique Centrale"). Each group constituted a monetary union functioning on the basis of its own Central Bank. Strong links were established between both these Central Banks on the one hand and the Central Bank of France. Even BCEAO and BEAC were located initially in Paris (France) before their Headquarters moved in 1974 (to Dakar in Senegal and Yaounde in Cameroon respectively). However, these events and changes did not affect the parity between the French franc and the CFA franc as it was still known. It remained at the same rate of 1 FF = 50 CFA. In addition the

two Central Banks continued to issue the same CFA. While it was still referred to as the CFA franc, the acronym changed meaning: ("Communaute Financiere en Afrique") replaces ("Colonies Francaises d'Afrique"). The new framework to govern the relationships between France and the countries using the CFA was now formerly referred to as the Franc Zone.

The third period of reference came with the 1974 reforms which concerned very particularly the UMOA. As will be seen in the next section, the rules governing the FZ put too much emphasis on the financial stability aspect, not taking enough account of the other needs for development of the african member countries. The reforms which occurred in 1974 aimed at the correction of this bias.

In what follows we start with a look at how the FZ is formed.

a. FZ membership.

At the beginning in 1960, virtually all the French ex-colonies in Sub-Sahara were members of the Zone. This means they had in common the CFA currency and belonged to the UMOA or the BEAC group¹. The members of UMOA at that time were: Benin (ex-Dahomey), Burkina-Faso (ex-Haute Volta), Cote d'Ivoire, Mali, Mauritania, Niger, Senegal and Togo. On the BEAC side, the members were: Cameroun, Chad, Congo, Central African Republic and Gabon. Some changes concerned UMOA. First Mali left in 1962 but eventually returned back in the FZ in 1984².

¹ Comoros which belongs to neither UMOA (BCEAO group) nor the BEAC group is also a member of the FZ.

² Crum (1984) gives details on this point of the Malian membership.

The case of Mauritania was different. In 1966, it quit the Zone and never returned. It is worth mentioning at this stage that the monetary grouping was paralleled by a trade grouping. In the western region of UMOA for example, the CEAO ("Communaute Economique de l'Afrique de l'Ouest") was created to promote trade between member countries. In a sense the CEAO was meant to complement the UMOA on the trade side. It was a tariff free area. One of the weaknesses of a structure like UMOA appeared clearly in the trade relationships of its members. The bulk of their trade was with France and to a less extent with other European countries. The institution of the CEAO was directed to impulse the trade at the local level. But the experience has shown little success since the intra-area represents only 15% of the external trade of the UMOA countries.

As for the BEAC group, a new member joined it in 1985. Equatorial Guinea, a former portuguese colony became the 6th member of BEAC and the 13th member of the CFA Zone. This is significant considering that the FZ included up to then only former French ex-colonies, although one could note that Equatorial Guinea represents a very small economy offshore Gabon, a geographical location and an economic context which favoured very much this move.

b. Small/large country portrait.

To start with, let us consider the relative size of the economies in question. It is obvious that each individual African country of the FZ represents a small economy with respect to the French economy in the sense this categorisation is used in

economics. In addition, the same can be said of the UMOA and/or BEAC as a whole, that the relative size of the African side in the FZ remains small and corresponds well to the reality of their little power in the decision-making of the FZ besides France. To give an illustration, UMOA's GDP in 1992 represented 2.0 % of France's GDP. The corresponding percentage for BEAC is even lower, 1.7 %. In comparison Belgium which may be considered a small economy with respect to the US has a level of GDP equal to 3.8 % of US GDP, that is the equivalent of the African side of the FZ compared with France. So the asymmetry in the decision-making and the relative size of the two economies give substance to our representation according to which the FZ appears as a monetary union between a small country, namely the group of the African members and a large country, namely France.

Now let us say more about the characterization of the FZ as a monetary union between a large economy and a small economy. The most important feature is without doubt the peg of the CFA currency to the French Franc which remained at a fixed rate unchanged since 1948 to the end of 1993. The fixed exchange rate regime gave the appearances of a monetary union between France and its partners because of this long standing fixity of the parity. Even the developments of the international monetary system in the early 1970's did not affect it. Indeed during the Bretton Woods era, fixed exchange rate regimes were the rule with very few exceptions such as the float of Canada. Developed countries of the western world maintained fixed rates around the dollar standard. Changes in parity were allowed along strict rules as defined by article IV of the IMF Statutes. Developing

countries followed the same pattern and most of them pegged their currencies to a key currency (dollar, sterling or french franc). When the system of fixed parities came to an end in 1973, the key currencies started to float among them. For the developing countries, they did not let their currencies float as such except for a few of them, but most of them started to quit the traditional peg regime. Instead they resorted more and more to a basket peg, crawling peg and other regimes which provided more flexibility. The peg to the SDR (Special Drawing Rights) for example provided a proxy of a basket that a number of countries have used. In 1976 the cases of peg to a single currency peg represented 62.6% compared with 23.4% of pegs to a composite and 14% of flexible arrangements. In 1989, these figures became respectively 38.2%, 28.2% and 33.6% respectively³. The pegs to a composite include SDR pegs and other currency basket pegs. The flexible arrangements regroup all of the other categories, the managed float for example.

Another feature of the FZ is that the convertibility of the CFA currency is guaranteed by France. In counterpart, the African members of the Zone are required to deposit 65% of their external reserves with the French Treasury in an account known as the operation account where all reserves are pooled. This account is seen as a central piece of the cooperation between France and its partners. But for long, the support by France as the guarantor per se of the system might not be that significant or at least proved to be very facilitated for two reasons. On the one hand, the overall balance of payments of the african members gave

³ These figures are given in Joshi (1990).

constantly a surplus up in the early 1980's. On the other hand, there is a proviso in the rules governing the CFA zone which requires that the necessary adjustments be implemented by the countries in deficit when the net assets go below a critical level. One might question whether or to what extent the latter rule itself had actually worked. The functioning of the FZ operation account as a pool of reserves needs nevertheless some emphasis as this allowed countries to run deficits of their balance of payments provided this does not last too long or result in an overall deficit for the group as a whole. France which acts as the guarantor of the last resort plays a key role to overview the mechanism and to decide in practice when an imbalance is deemed unsustainable.

Another characteristic is that there are no capital controls within the Zone. Capital can move freely between any two countries including France. The three elements (fixity of the parity, convertibility of the CFA and free mobility of capital) combine each other to give to the FZ the characteristics of a monetary union between France and the members of the FZ. It holds true that the three Central Banks (the French Central Bank, BCEAO and BEAC) are different, managed by different bodies. But it is quite clear that BCEAO and BEAC cannot act independently of the Central Bank of France. One might say that for long, BCEAO and BEAC appeared as branches of the latter: in the UMOA case for example, the Board of Executive Directors⁴ consisted of 12 representatives from France and 12 from the UMOA countries (2 per

⁴ Let us note also that the Board of Executive Directors is not a currency Board.

country). But, and in support of the asymmetric representation small/large country, the UMOA did not have any representation of this sort at the French Central Bank bodies. One could note that later with the reforms the number of 12 representatives from France was reduced to two.

1.2. The CFA area : the case of UMOA

A description more in detail of the FZ is proposed in what follows. But the description will be limited to the UMOA case to simplify and also given the strong similarities between UMOA and its counterpart in the central region. In fact the same construction has been applied to geographically different groups so to say if one had to compare the two institutions.

a. Structures

The UMOA countries have in common the CFA currency and a common Central Bank as mentioned above. The body charged with the management of the monetary policy within UMOA is the Board of Executive Directors in which each country including France has two representatives. It is presided by the Governor of the Central Bank (BCEAO). The voting procedure has put emphasis on the solidarity between the member countries. Although the economies have significantly different sizes (Cote d'Ivoire and Senegal constitute the two main economies), the voting system does not introduce a differentiation along these lines: it follows "one member one vote " rule. If one had to find some trace of the way the relative importance of the economies of the member countries is taken into account, it might be in the fact

that up to now, the Governor is a representative of Cote d'Ivoire and the Headquarters of BCEAO are located in the capital of Senegal while the other countries take the posts of Vice-Governors in turn. In any case the principle of solidarity seems to work well and it includes the system of reserve pooling through the operation account.

Above the Board of Executive Directors, we have the UMOA Conference of Ministers, attended by the Ministers of Finance and Plan from each country. This Conference supervises the work of the Executive Directors and represents the appropriate forum setting for the monetary policy. Finally we have the Summit of the Heads of State which meets annually upon questions of general orientations and also constitutes the appropriate level to examine for example issues of membership (withdrawal or new entry) or nomination of the Governor. At the Summit level as well as the Ministerial level, each UMOA member country takes the presidency in turn.

The Central Bank, BCEAO, from its Headquarters in Dakar ensures its coverage of the different economies of the area by means of its national branches. The national branch has a key role to play for the success of the overall policy of the BCEAO. Its staff has clearly the status of belonging to the Central Bank staff and in no sense to the national administration. Its Director is chosen from the Central Bank staff and nominated by the Governor after consultation with the national Government.

The role of the national branch has two main aspects. First it is present at the starting point when the Central Bank engages in the process of assessing the needs of each economy. Every

year, the staff of the national branch undertakes, in liaison with the national administration an assessment based on the forecasting of the economy for the year ahead. The task aims at the determination of the money supply which will be required. The results of the exercise are then put through to the Headquarters. At the level of the Headquarters, after having received the different proposals from the national levels, the Central Bank has to put them together, evaluate their consistency with the level of net assets of the individual country in question and also their consistency with the overall financial situation of the group and the resources of the Central Bank. Having completed this task, the Governor then presents the new proposals, modified as necessary, back to the member countries via the Board of Executive Directors and the Ministerial Conference.

The second aspect of the role played by the national branch regards the implementation of the monetary policy. How it carries out this in liaison with the national Government can be best captured by looking at the activities of the Credit Committee ("Comite National du Credit"). Placed under the presidency of the Finance Minister, the Credit Committee as its name suggests, monitors the credit counterpart of the money supply. Indeed the decisions taken at the level of the Central Bank and the UMOA allocate the aggregate money supply between the member countries on the basis of the balance of payments constraints, the inflation target and the projected level of output. Monitoring the level of credit channelled into the economy represents the mean of achieving the objectives of the monetary policy.

The task of the Credit Committee is greatly facilitated by the UMOA rule about the financing of Government deficit. The finance provided by the Central Bank to the Government should not exceed 20% of the fiscal receipts obtained in the previous year. This leads the Committee to focus on the other allocation of credit. There is even a further simplification in the sense that a significant amount of the private economy goes to the financing of the cash crops like coffee, cacao, groundnut, cotton etc... The Government determines the prices to the producers as official prices. The quantities of the harvests sold in the official market are well known. In general, the Central Bank accepts to finance these agricultural products automatically, without any restriction and to adjust its initial target of money supply if necessary, for example when the level of harvest proves to be higher than initially expected. The cash crops are essentially export goods and the more a member country has of them, the better for the balance of payments. However one difficulty which arises very often relates to the relative price paid to the producers of the cash crop compared with the world market price. If for example, the export price gets less than the price to the producer and that the Government chooses to subsidize the cash crop, then the national Treasury has to pay for the differential to the primary banks which participate in the financing scheme. In case the Treasury fails to pay on time, the corresponding amounts are converted into normal credit and this may crowd out the other sectors of the private economy.

The way the Credit Committee deals with the money lending to the companies takes the following form. It decides a maximum amount

beyond which the commercial bank which is lending money needs approval of the Committee. The procedure goes through the national branch. The maximum amount criterion applies to the total of money a given company can borrow in a year.

The functioning of the UMOA as just outlined seems to give more freedom of action to the Central Bank than is usual in the developing world where the independence of the Central Bank is usually curtailed. This is most damaging in terms of inflation record to the extent that the Government does not find other domestic sources of financing its deficit but the cash from the Central Bank. In the context of UMOA, the multilateral status of the Central Bank seems the most prominent factor to give it more leverage for the conduct of the monetary policy. One can take the case of the rule about Government financing which requires the credit from the Central bank not to exceed 20% of the fiscal receipts of the previous year. Any given member country will be deterred from free-riding because it will face not only the opposition of the Central Bank but also the disapproval of the other member countries. In the domain of Government financing and other domains, free-riding for whatever reason would represent a real threat to the system.

A collusive behaviour may occur however. Let us imagine the case where the sum of the money supplies which are desired at the level of the national level exceeds the level that the Central Bank would recommend. If each country was concerned only with obtaining its desired level of money supply, in principle the Central Bank seems powerless to oppose such a demand in view of the present structure except for the representation of France at

the Board of Executive Directors. One may therefore think that the system will not work well without the French representation. But it is difficult to establish a priori an element of validity about the assumption of collusive behaviour. In any case taking account of such fears, the departure of France would imply reinforcing the powers of the Governor.

The present structure has some advantages which need to be preserved as far as possible. Namely, the diversity of the situations and specific needs of the different member countries should find a way through to the Central Bank concerns. The representations of the member countries in the institutions of the UMOA seems to provide a channel for the expression of the national preoccupations and needs. Is it feasible to augment the independence of the Central Bank without wiping out these possibilities of communication and feedback? Again, in case France happens to leave for whatever reason, the way forward for the member countries would consist of accepting some sacrifice by delegating more prerogatives to the Governor. At the same time, an improved structure may be put in place to approximate the representative role of the present structure. The real challenge will be about the relationship between the monetary policy and the other economic policies for each individual country and the national policies between them.

b. The 1974 reforms

The UMOA system as it worked during the first decade of its existence showed a number of unsatisfactory aspects. This had led to the decision to undertake reforms in November 1973, the so-

called 1974 reforms. Our review includes two years only of the period before the reforms. Consequently the description given above refers to the new system after the reforms took place. Whatever the limits of the results obtained by UMOA since then, it seems worth having a look at what the reforms attempted to do and to what extent they represented a milestone in the life of the organization.

First, it is with the new Statutes that came the institution of the Conference of the Heads of States as indicated earlier on. Also the new Treaty decided the change of the location for the BCEAO headquarters from Paris to Dakar. During all the first decade, the common Central Bank operated from Paris. It did so through the national branches it established in each country. The national branches were themselves managed by representatives from France. The changes led to the replacement of the latter by the domestic staff of the BCEAO, the sense of which was given to mean "a step not directed against a particular or collective interest but as a fair and legitim aspiration..."⁵.

The new Statutes continued to give much weight to the financial stability in UMOA. The provision to undertake the necessary adjustment, by increasing the rediscount rate and other complementary actions as soon as the ratio of external assets to the short term liabilities falls to a critical level (as a result of deficits of the balance of payments) remained at the same place. But two key words appeared in the new text, that is, development and harmonisation (of the economies). The creation

⁵ Speech by the BCEAO Governor at the ceremony of nomination of the Senegalese Director of the BCEAO agency in Dakar.

of a common Development Bank, BOAD ("Banque Ouest-Africaine de Developpement"), occurred to respond to the development objective. The BOAD was created to support the investment effort in the UMOA area. Its capital had been subscribed half by the Central Bank BCEAO and half by the UMOA member countries.

The coordination of fiscal policies had been a concern. The lack of it can impinge on the effectiveness of conducting a common monetary policy. For example, Government deficits have a direct effect on the balance of payments of the country in question and also of the group as a whole, everything else being equal. However coordination in the fiscal domain remains very limited in the light of what the reforms introduced. Before 1974, the overall ceiling or allocation to each country by the Central Bank bore on the credit to the private sector, to the exclusion of the financing going to the Treasury. The latter category of financing was governed by the Statutes that it should not exceed 15%. The reforms set the limit up to 20%. In addition, the overall ceiling of credit that the Central Bank will allocate to each country will extend to include the bank financing received by the Treasury, according to the new Statutes which leave to the National Credit Committee the charge to determine the share between the private sector and the Government Budget. But the right of each Government to resort to the financing by the Central Bank, provided the amount does not exceed the 20% limit, was clearly expressed. Because in practice, the limit has proved to be a binding constraint, there is little change compared with the previous situation.

The reforms aimed also at dissipating the view that the

financing by the Central Bank was automatic. This view resulted from the fact the Credit Committee used to set refinancing ceilings to commercial banks as well as to individual enterprises. The new rules abolished such specific allocations although the practice to some extent seem to have settled again along the pre-1974 lines. Also the distinction between the credit eligible to the Central Bank discount and the non-eligible credit was dropped as well. The Central Bank was however still faced with the problem of the banks using their own resources to finance the demand for credit from their customers. This case arose in periods for example of commodity price booms. In addition, the banks used the facility given to them and allowing them to borrow external sources for their domestic lending.

The reforms gave to the Central Bank the green light for a more active policy with regards interest rates. The developments on the international financial market required some adjustment in the role of the BCEAO about interest rate policy. The diagrams 1.1 and 1.2 show how the deposit rate and the money market rate had to mirror the changes in the interest rates in France. The same could be said of the lending rates, marking the departure from a policy of cheap money which characterized the approach of the Central Bank during the pre-reform period. At the same time, the objective of development emphasized in the new Statutes led the Central bank to introduce preferential rates for some categories of credits. The favourable treatment applies essentially to the financing of cash crops and the lending to small and medium enterprises. The concerns of the reformers also led to the set-up of a money market covering the UMOA area. The

management of the money market was given to the Central Bank. The reformers with this creation aimed at promoting the possibilities of capital movements within UMOA and more efficient allocation of resources at the sub-regional level. The decision was complemented by the limits placed on the banks about the amounts of liquid assets they can keep abroad.

It appears that the parity between the CFA currency and the French franc to which the former is pegged was not affected by the reforms. As before, any change in the parity will require the agreement of every member country and France. The convertibility of the CFA currency was continued with the support of France, and the UMOA countries having to deposit part of exports with the operations account open in French francs in the books of the French Treasury.

Other measures brought about by the reforms concerned the issue of bank control. The mechanism of control in each country was a body which involved both the Government and the Central Bank. But the situation of financial troubles that the banking system experienced in the late 1980's tends to demonstrate that the safeguards did not work. The main weakness was that the aims and means of action were not clearly specified. In Senegal the difficulties affected very seriously banks such as ex-BCS, ex-BIAO, ex-USB and other financial institutions. While BIAO and USB managed to remain alive through restructuration plans with a modified ownership becoming respectively CBAO and Credit Lyonnais, all of the others in trouble disappeared, including those which were set up to promote development in specific sectors (agriculture, tourism, fishing...).

The difficulties which confronted the banking system recently has led to the creation of a new institution of control, separate from the Central Bank, acting at the UMOA level as a whole.

c. The policy instruments

The previous subsection has touched upon the financing of the economy by the banking system. This is a central aspect for the concern of the monetary policy. We have already indicated the procedure whereby Governments of the UMOA can get financing from the banking system. The rule which allows member countries to resort to the domestic banking system only up to a given proportion of their fiscal receipts as fixed by the Statutes, represents a powerful deterrent against too much inflation finance. But it is worth examining what the practice has indicated.

One can say that the rule has been literally followed. However this has not influenced Government budget imbalances. In practice, the Treasury usually has tapped other sources of finance instead of restraining itself to the amount available from the Central Bank. The main alternative has been to resort to external borrowing. Huge amounts have been borrowed from abroad to finance public investments essentially but not exclusively, the experience has shown that some of this amount has gone to finance the current consumption in the form of subsidies for example. The two other elements of Government financing have taken the form, first of payment arrears due by the Treasury to domestic companies which provide it with services , and second, of the financing given by the banks to parastatals.

In the latter case, it does not make much difference whether the lending goes to the Treasury or to the parastatal since the Government provides the explicit or implicit guarantee of last resort to the parastatal.

The refinancing by the Central Bank and the reserve requirement against commercial banks deposits represent the two main tools the Central Bank has to influence the liquidity in the economy. In principle, any primary bank which has lent to a company can turn to the Central Bank and submit the loan for refinancing. Also, a priori, the Central Bank can enforce reserve requirements on to the commercial banks. This aims to the reduction of the liquidity the banks can use for lending. In practice, the Central Bank has not used the tool of reserve requirement. As for the refinancing, it has been considered for long as quite automatic or at least it has actually functioned like that. At other times, the difficulty took another form. Because it did not use the instrument of deposit requirement, the Central Bank was faced with the problem of some banks which had enough liquidity to bypass the refinancing constraint, especially in periods of commodity booms.

In the UMOA, quantitative control has constituted more and more the instrument for monitoring the level of credit. The method can be described as follows. Each year, the growth of the total credit for the national economy towards the companies and households is determined as a result of the decision which sets the objective and means of the monetary policy. That growth rate is then applied to the amount each commercial bank lent in the previous year. This determines the quantity of money a given

commercial bank will be allowed to lend to its customers. The advantage of the method seems its simplicity. But some concerns arise because it gives an edge to the biggest banks and it does not reward those banks which strive to be more successful and to increase their share of the domestic market. Combined with unrealistic interest rates, this may lead to inefficiency in the allocation of resources.

The UMOA has a common policy about interest rates. The deposit interest rates are the same in the different countries. The same rule applies for the other categories of interest rates: lending rate and money market rate. In addition, these rates cannot differ substantially from the rates prevailing in France: as indicated earlier on, there exist no capital controls within the FZ. Consequently any divergence between interest rates in France and UMOA would provoke in principle a significant movement of capital towards the former if it offers a higher rate.

The comparison between the deposit interest rates can be seen in fig 1.1 which covers the period 1972-92. The period of the early 1970's corresponds to a sharp rise in the interest rates. But the interest rate of UMOA was relatively stable between 1976 and 1982 compared to the rate in France. From 1982, a strong correlation links the two rates. The same can be said of the money market rates all along the period 1978-1992⁶. One can note that from 1984 and increasingly, the interest rate in UMOA displays a margin with respect to the rate in France. We attribute this differential to the effect of expectations that

⁶ The data set starts from 1978 for the UMOA money market, corresponding to its date of creation following the 1974 reforms.

Fig 1.1: Deposit interest rates

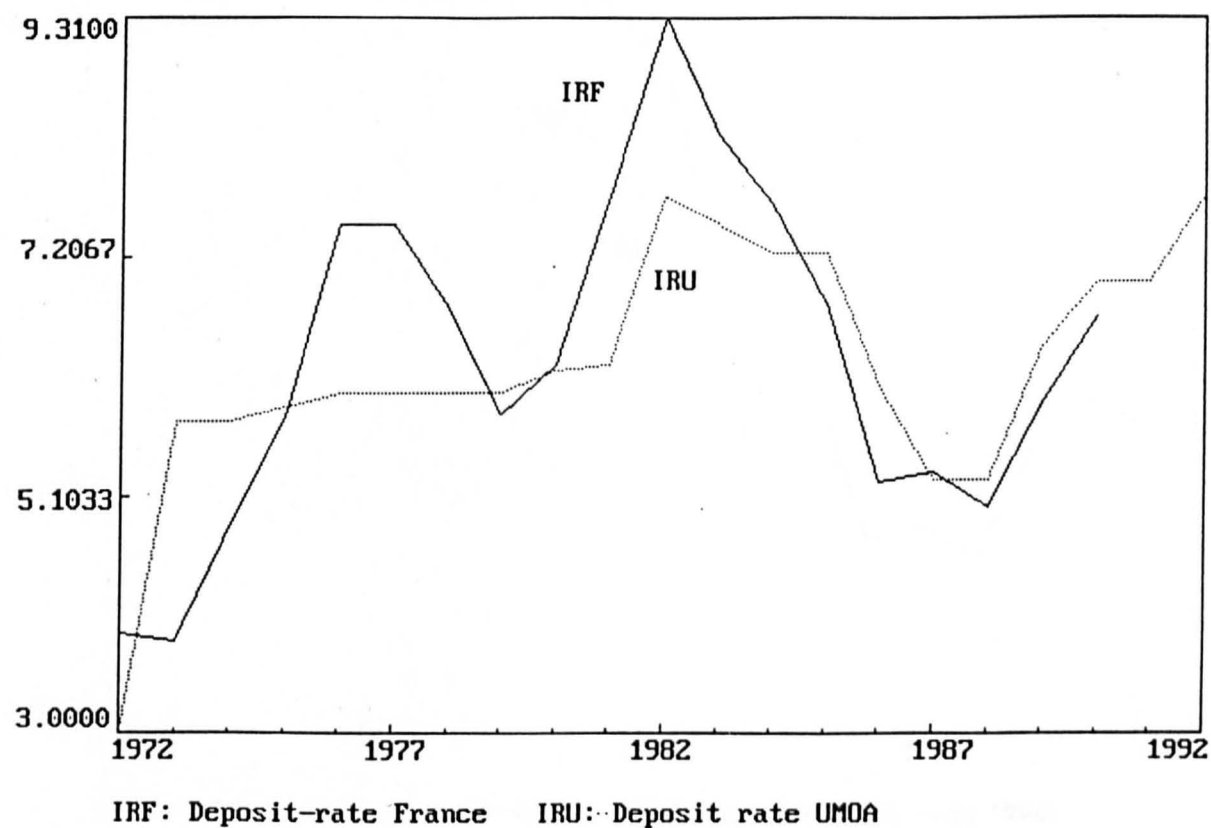
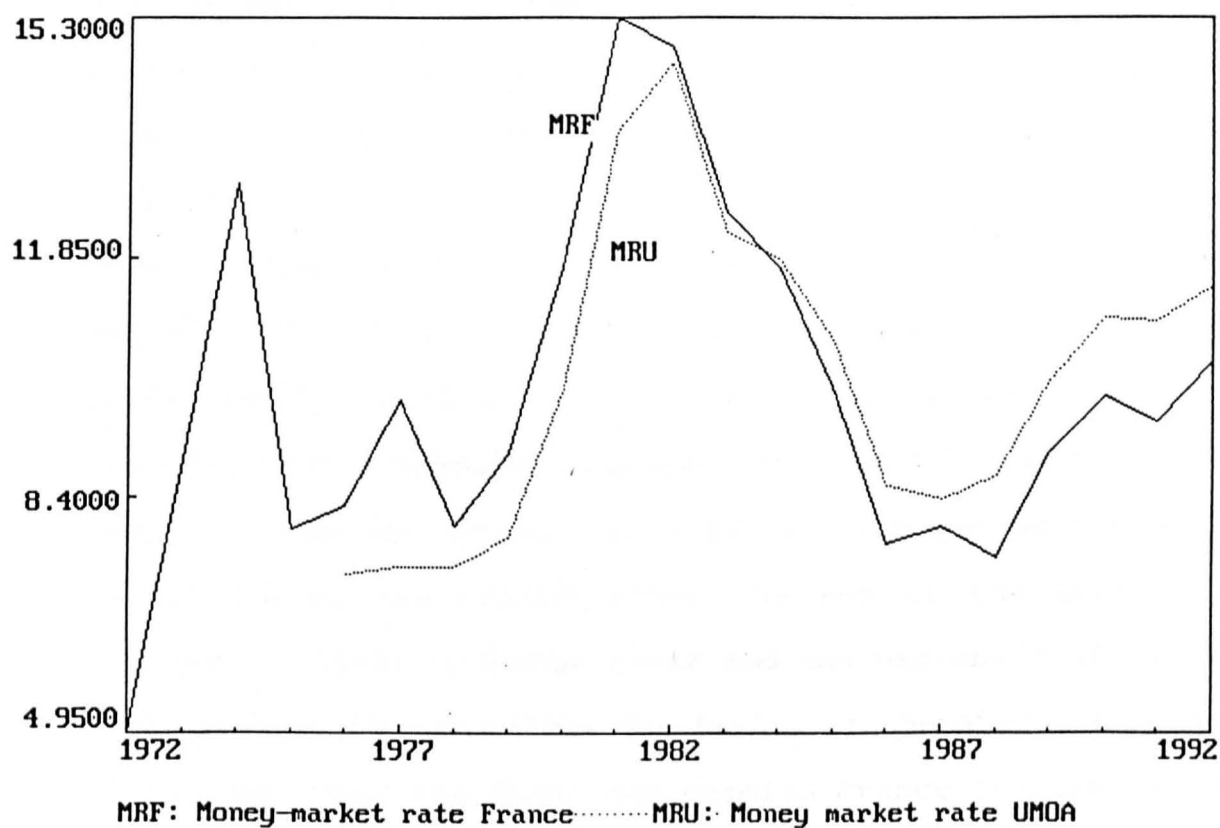


Fig 1.2: Money market rates



there might be a change in the parity of the CFA currency. Indeed this period is where some devaluations of the FF occurred. Also, as a matter of fact, the prospect related to the "Project '92" of a common market in Europe was seen in some sections of the UMOA area as the signal of possible changes in the FZ system. Several times, the monetary authorities had to make declarations to reassure the market that the parity of the CFA/FF would not be affected.

Fig 1.3 compares the discount rate in France and UMOA during the period 1972-92. The discount rate in France went up sharply between 1972 and 1974. It fell back close to the 1972 level and then fluctuated somewhat between 1975 and 1977. From 1977 until 1992, it remained constant at 9.5%. The sub-period can be viewed as the transition period after the end of the Bretton Woods standard of fixed exchange rates and the beginning of the system of floating exchange rates. The fixity of the discount rate seems to indicate that the float has enabled France to have in control the domestic monetary policy. Fig 1.4 shows that the ratio of the money supply to GDP (Gross domestic product) has remained relatively stable during most of the period under review.

In contrast, the discount rate in UMOA had been prone to more fluctuations. From 3.5% in 1972, it kept increasing step by step up to 12.5% in 1982. It then varied significantly: first a decrease down to 8.5% in 1987 followed by an increase up to 12.5% by 1992. The money growth in UMOA seems to have been a worry and to constitute the reason for this increase in the discount rate (fig 1.5). The ratio of the money stock to GDP for both Cote d'Ivoire and Senegal, the two main economies of UMOA, increased

Fig 1.3: Discount rates

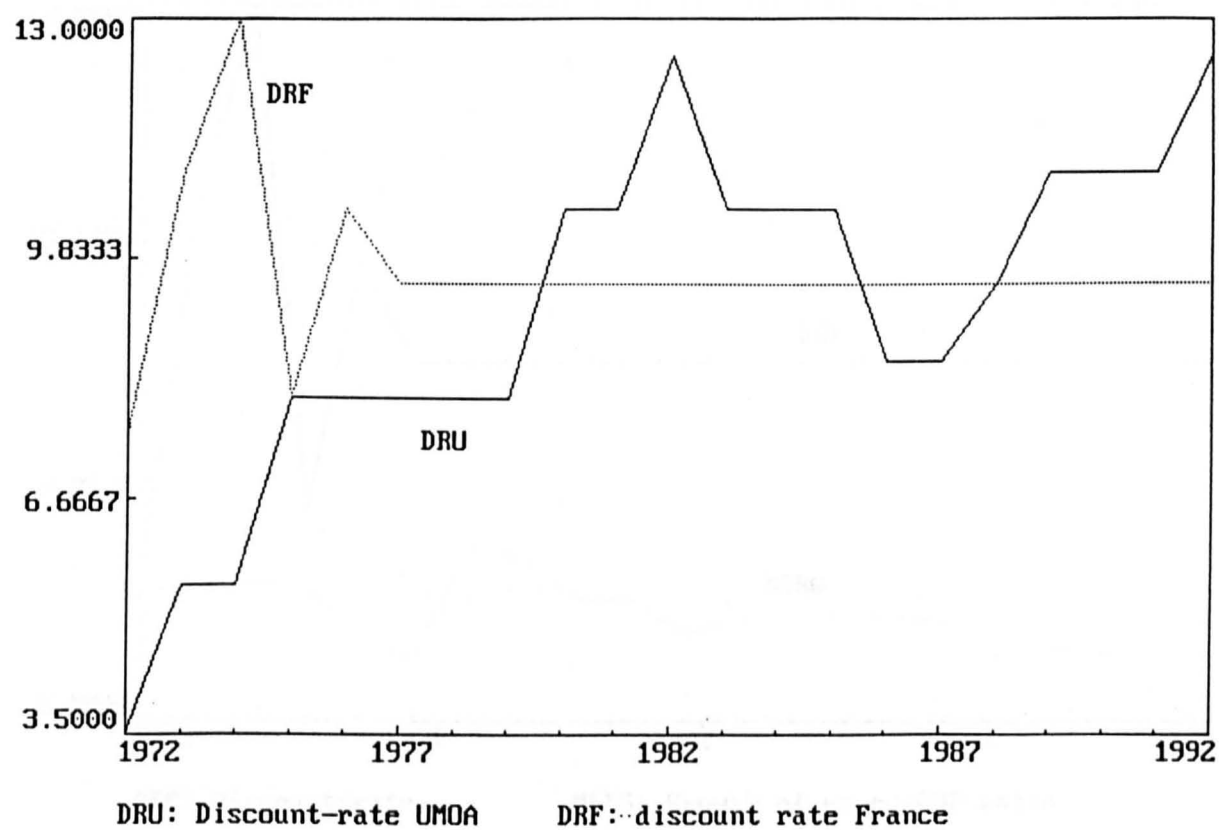


Fig 1.4: discount rate and Money/GDP, France

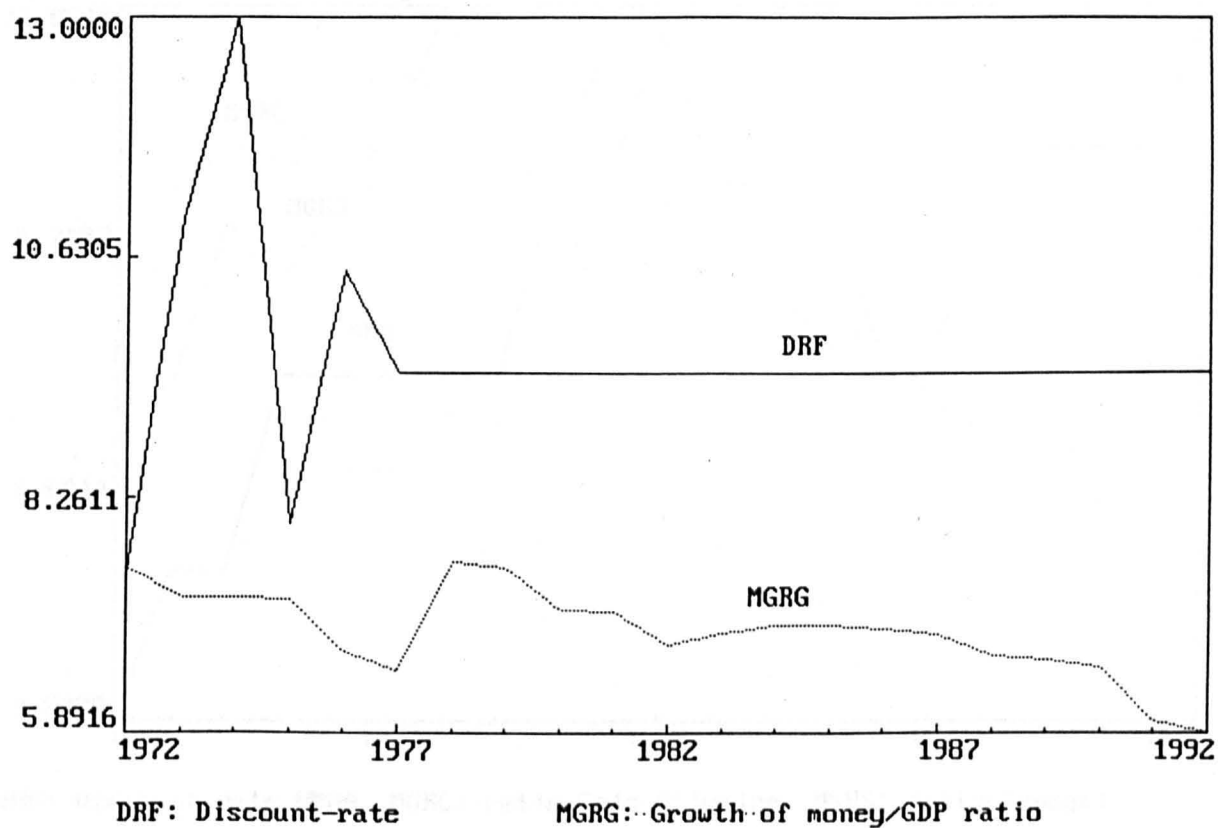
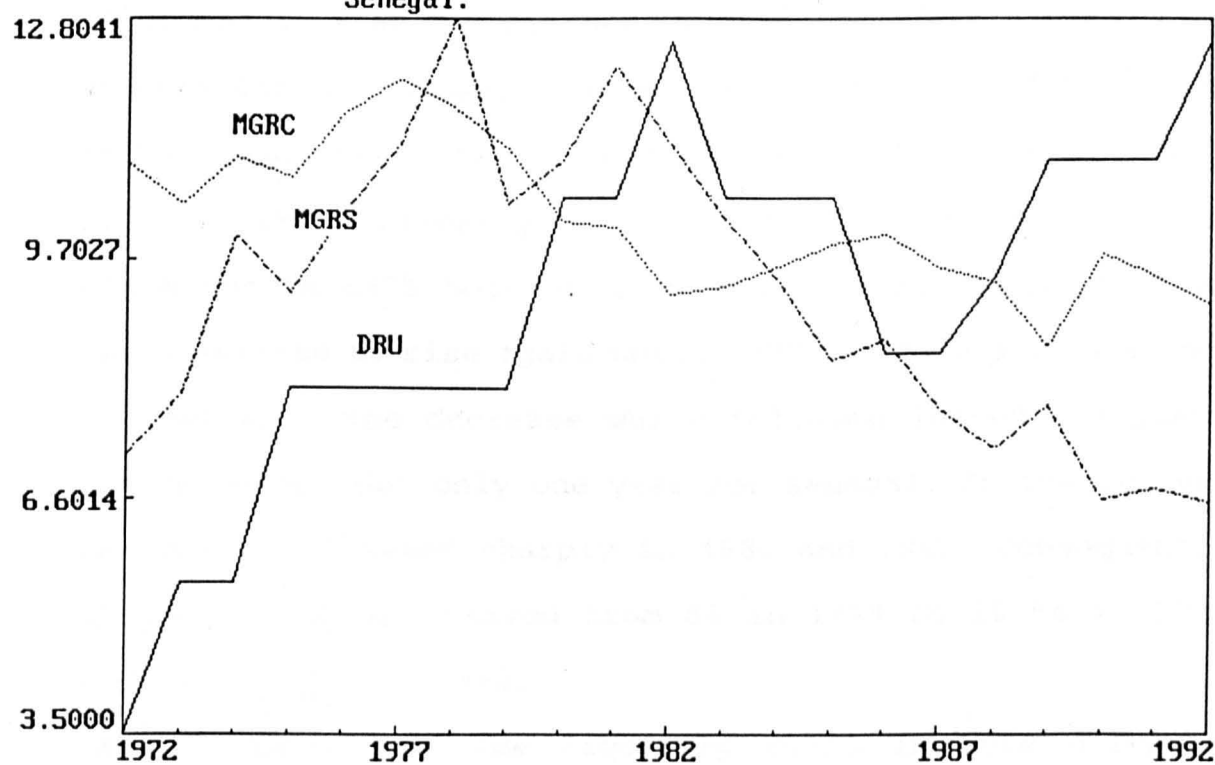


Fig 1.5: Discount rate and money/GDP ratios, Cote d'Ivoire & Senegal.



DRU: Discount-rate-UMOA MGRC: ratio Cote d'Ivoire MGRS: ratio Senegal

significantly between 1972 and 1977/78. Inflation was running high at 15% in Cote d'Ivoire and Senegal. The discount rate was increased in a sort of response to counter the increase in the liquidity.

A closer look at the picture reveals the difficulties one faces in establishing an appropriate monetary policy in UMOA. After the initial increase, the discount rate was maintained constant from 1975 to 1979, probably at the view that the money/GDP ratio decreased in 1975 both in Cote d'Ivoire and Senegal. Then the ratio started to rise again until 1977 for Cote d'Ivoire and 1978 for Senegal. The decrease which followed lasted six years for Cote d'Ivoire but only one year for Senegal. In the latter case the ratio increased sharply in 1980 and 1981. Consequently the discount rate was raised from 8% in 1979 to 10.5% in 1980 and 1981 and 12.5% in 1982.

But we note that the liquidity ratio in Cote d'Ivoire was decreasing during the sub-period 1978-82. The increase in the discount rate was directed to counter the liquidity problem in Senegal, which may penalise the other economies which do not have such a problem.

The situation is reversed afterwards. One can see that the reduction in the discount rate had responded to the decrease in the liquidity in Senegal, down from 12.5% in 1982 to 8.5% in 1986-87. Meanwhile the liquidity in Cote d'Ivoire started to rise again from 1983. Eventually the Central Bank responded to this increase by raising the discount rate to 9.5% in 1988 and 11% in 1989. During this period the liquidity in Senegal was down to a record low. The increase in the discount rate this time was meant

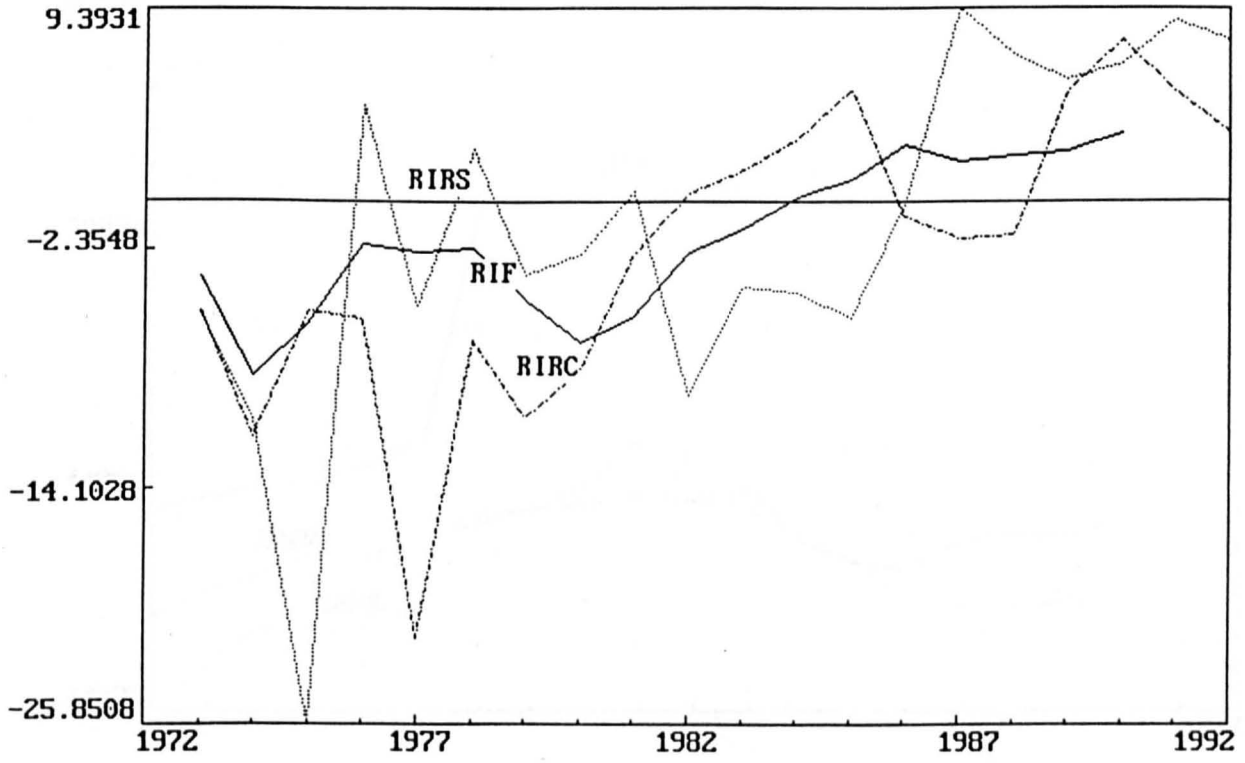
to address the liquidity problem in Cote d'Ivoire. But this penalized the other member countries with normal or even less than normal liquidity.

We see the type of difficulty in setting a common monetary policy. The method adopted by the UMOA seems to have been the following, that the instruments or actions were directed at the specific economy in which an overliquidity had appeared, even if this means that the other economies might have suffered from these actions.

The same type of problem can be seen for the establishment of the deposit rates. After taking into account the inflation rate in the three countries, the real interest rates have different profiles. The real interest rate in France fluctuated and remained negative up into the early 1980's. But it became positive for the rest of the period and in an upward trend. The real rates in Cote d'Ivoire and Senegal seemed to vary in an inverse relationship. Because the inflation rates differ significantly, the common deposit rate in nominal terms leads to a different behaviour of the real rates. Only from 1988, do we observe a positive rate for both countries as can be seen in fig 1.6.

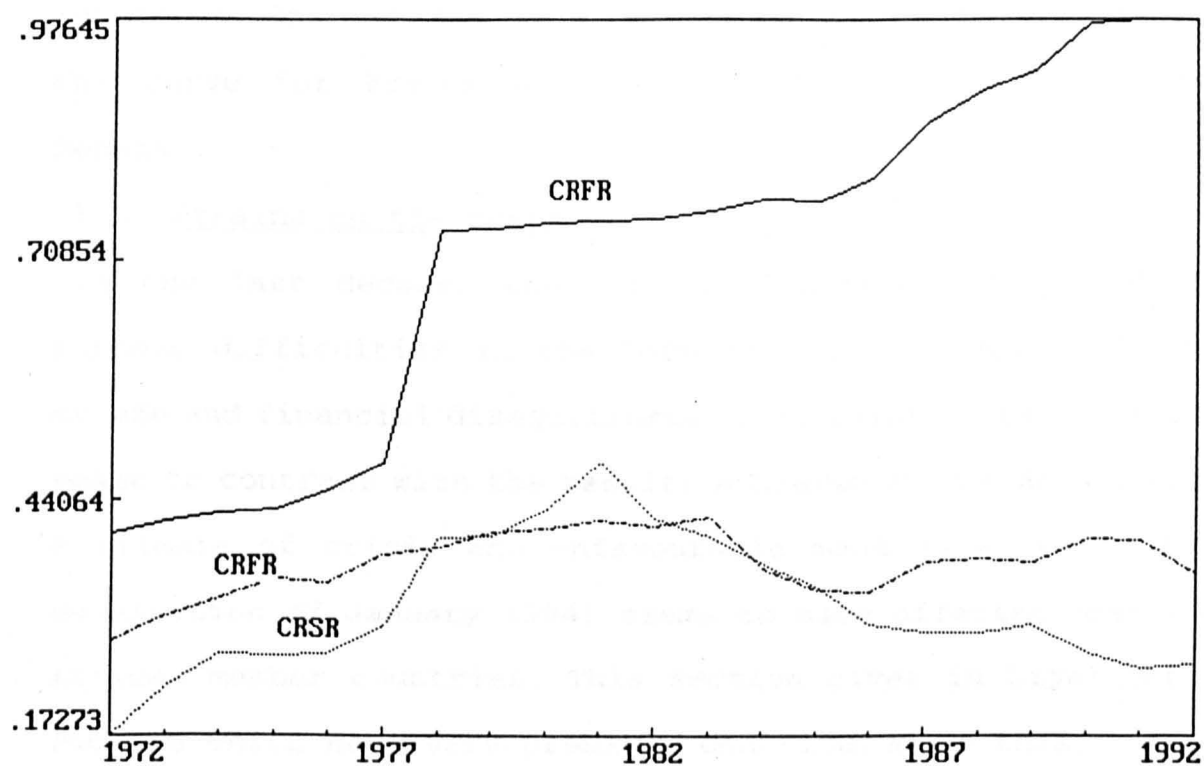
The curves of fig 1.7 relate to the lending offered to the private sector, namely the line "Claims on the Private Sector" in the Monetary Survey of the IFS classification. They depict the ratio of these claims to GDP for France, Cote d'Ivoire and Senegal. If one takes the case of France as the standard, then the financing of the private sector seems to have performed not very well in UMOA. The levels for Cote d'Ivoire and Senegal at

Fig 1.6: real interest rates: France, Cote d'Ivoire and Senegal



RIRF: Real rate, -France- RIRS: Real rate, -Senegal- RIRC: real rate- Cote-d' Ivoire

Fig1.7: Private credit/GDP: France, Senegal & Cote d'Ivoire



CRFR: Ratio-France CRSR: Ratio-Senegal CRCR: Ratio-Cote-d'Ivoire

the starting point in 1972 are clearly lower, and after a mild increase they remained roughly constant except for Cote d'Ivoire which benefited a sharp increase in 1981. After 1983, the relative claims to the private sector decreased in the two countries. One can observe a very large gap in the 1980's between the curve for France and the curves for Cote d'Ivoire and Senegal.

1.3. Strains on the system

In the last decade, the African countries of the FZ faced serious difficulties in the form of slow or negative economic growth and financial disequilibria. This relative bad performance seems to contrast with the results achieved in the decade before. A climate of crisis and unfavourable mood (i.e. prior to the devaluation of January 1994) seems to have affected most of the African member countries. This section gives in highlight some factors which have very probably contributed to this.

a. France more in Europe

The long relationship between France and its African ex-colonies in the FZ appears more and more challenged by the appeal for France to get closer and closer to its partners in Europe. France has rights and duties in Europe which appear different from the situation in the FZ. The rules of the game on one side differ from the other side in a sense unfavourable for the member countries of the FZ.

One example of illustration is the trade relationship between France and some countries like Senegal. The latter received a favourable treatment from France with regard some of its exports

in that the commodity export price was kept above the world level. This special treatment had to be dropped in the process of establishing the Common Market in Europe. More generally, African members of the FZ took simply the status of ACP (African, Caribbean and Pacific) partners of the EC and there was no longer a difference between the FZ members and the other ACP members as far as France was concerned through the activities of the EC, in matters of trade for example. The existence of the FZ and what might be viewed as a permanent peg of the CFA to the French franc would normally imply a framework oriented to facilitate further the movement of goods and production factors within the Zone. Instead the trend has taken the inverse direction with regard to the relationships between France and its FZ partners.

Also a matter of concern the adjustments of parity affecting the FF. They can be traced back to 1969 for the period relevant to the experience of the FZ countries, that is from 1960 on. The devaluations of the FF have always been associated with the bumpy road of France into Europe. This is important to the FZ issue since these devaluations have cast the most striking contrast with respect to the unchanged fixity of the parity between the CFA and the FF for almost half a century. Why, it could be asked, can it be right for one rate to be rigid while the other adjusts so often? This is a key issue which needs to be examined.

Considering the FZ raises the question of what next, such as more economic integration or something like that between African members of the FZ and France. An observer from the 1960's would have asked the question several times only to realise the standstill. The fact is that France could not embark upon closer

economic links on both fronts at the same time. The program of a Common Market in Europe set the limits beyond which the trade links and related forms of cooperation between France and its FZ partners could not go. As a matter of fact, the progress towards an economic integration in Europe has presented the FZ system as actually falling behind, more marginal than ever.

The FZ has really no prospect more than to remain a simple currency peg between a small country and a large country, as far as the economic relationships are concerned. The experience up to now in the construction of a monetary union in Europe tends to confirm that view which is quite obvious to some respect, were not the long fixity of the parity CFA/FF.

On the monetary front, the program and the developments in Europe all display the profile of "le fait accompli" from the point of view of France's partners in the FZ. It is not an exaggeration to say that the CFA countries attended the journeys in and out of the "Tunnel" as well as the periods of turmoil in the EMS, but their attendance was the most passive possible. One positive interpretation of these facts would be that the FZ countries behaved as partners devoting their lot to their large partner which in turn was in charge to promote the conditions of exchange rate stability at the international level. A less favourable view would present the actions of France as simply more motivated by its concerns about Europe, completely disconnected with the situation in the other FZ countries.

In any case, most observers admit that the difficulties of 1969, resulting in the devaluation of the FF and the revaluation of the Deutch Mark brought about the resolution to set up a framework

towards more monetary integration in Europe. The second Barre plan and the second Werner report represent centrepieces in the process which constituted the background of the "Snake" (in the Tunnel) arrangement created in 1972. But France left in 1974, returned in 1975 before leaving it definitively the following year. A number of other countries experienced difficulties in maintaining their currency stability with the Snake.

In 1979, a new system, the EMS, replaced this arrangement. The view of close observers of the EMS at its creation considers that the decision to set it up was a political one more than an economic one. To that extent, it may be difficult to assess directly the relevance with the question of the FZ countries. However one can note the relatively large number of currency realignments within the EMS during the period 1979-86, again from the viewpoint of the FZ countries. To take the cases most relevant given the level of trade with the FZ, there were seven reevaluations of the DM, five devaluations of the Lira and, four devaluations and one reevaluation of the FF. For the latter, the devaluations occurred successively in 1981 (3.5%), 1982 (5.75%), 1983 (2.5%) and 1986 (2%). After a period of stability from 1987, another shock occurred in the summer of 1992 which led to the reform of the Exchange Rate Mechanism (ERM) and "the widening of the maximum fluctuations limits for the bilateral rates".

Despite the 1992 crisis, one important feature of the EMS is the commitment of the member countries to coordinate their economic policies. For the mechanism to work, a certain degree of economic coordination is required. This means the need for inflation convergence. In the first half of the 1980's, some EC countries

including France and Belgium undertook deflationary policies to meet the constraints as implied by the mechanisms of the EMS. In case where the national rates did not converge enough, the differential led to the realignments of the concerned currencies. Clearly, the European dimension has taken an increasingly part in the definition and the implementation of the economic policies in each EC country. France is no exception. Its economic policies have more and more abode to its European membership. The Maastricht Treaty, in creating the European Union is the latest move towards more integration. In that sense, France has got closer to its European partners in contrast to its relationships with the other FZ member countries, which may be characterized as a mere rigid status-quo.

b. The dimensions of the shocks

During the period under review 1972-93, the world economy witnessed a number of perturbations which cast a contrasting picture compared with the period before. The developing countries were adversely affected. This marked actually the "end of the golden era" for most of them. The disturbances in question range from the commodity price variations to the fluctuations between the key currencies and the movements in the interest rates on the international financial markets. As very small but largely open economies, the African FZ countries faced directly these external disturbances. Some of them experienced, in addition, severe domestic shocks such as droughts and crop failures. Against this background of a particularly unstable environment, the continued fixity of the CFA peg provided the very contrast of the period.

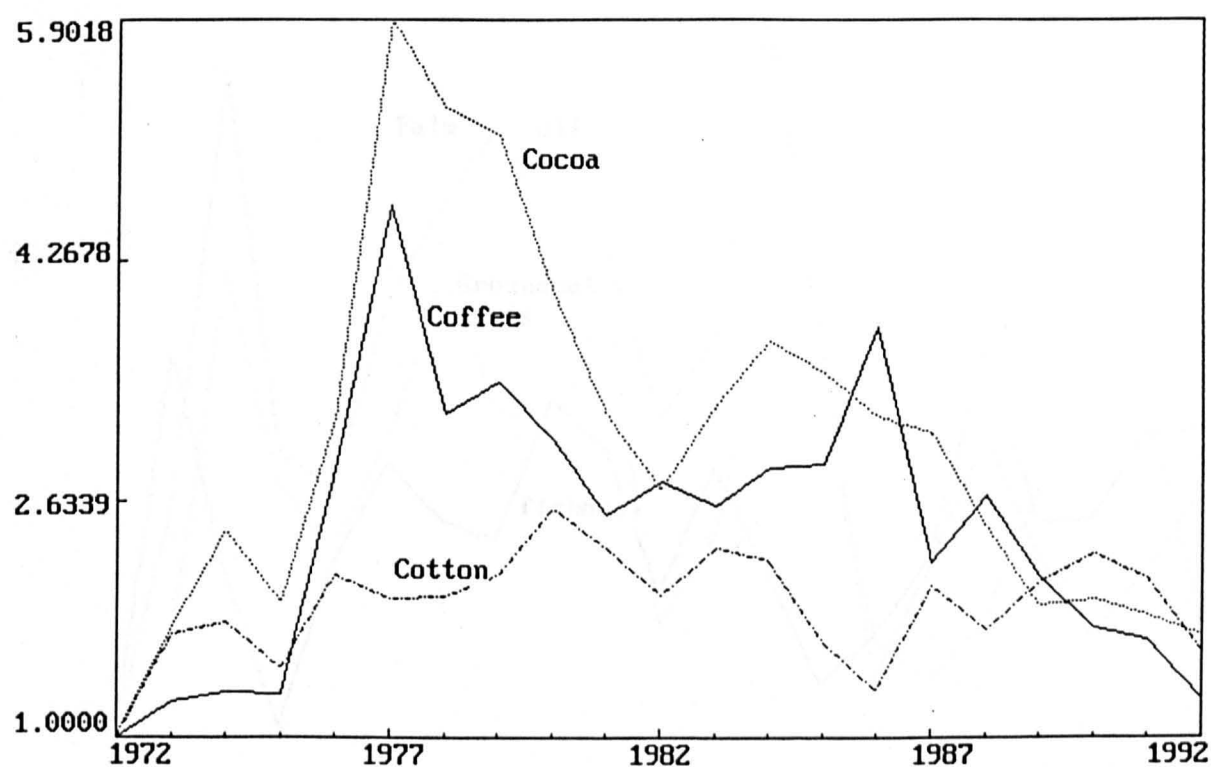
(i) The commodity prices

The African members of the FZ are typically commodity-exporting economies. Generally, each of them relies for its exports on one or two of the following commodities: coffee and cacao, cotton, fishmeal, groundnut oil, palm oil, petrol, phosphate and uranium. On the other hand, rice represents a largely imported good and its price may affect significantly the terms of trade. Diagrams 1.8 to 1.10 give an illustration of the fluctuations. Some additional comments will concern some of the commodities.

The price pattern between 1972 and 1992 is similar for cocoa and coffee, marked by a sharp increase during the sub-period 1972-1977. The price reached an all-time record in 1977 with 172.0 US cents per pound compared to 29.1 US cents per pound in 1972 for cacao, and with 234.7 US cents per pound compared to 50.3 US cents in 1972 for coffee. Then for the rest of the period, there was a sharp and sustained decrease in the price of both products, except for a slight upward change in 1983-84 for cacao and 1984-86 for coffee. Towards the end of the period in 1992, the price of cacao was back at its level in 1973 with 50.4 US cents per pound. The same applies to coffee: the price fell back to 63.66 US cents per pound close to its 1973 level.

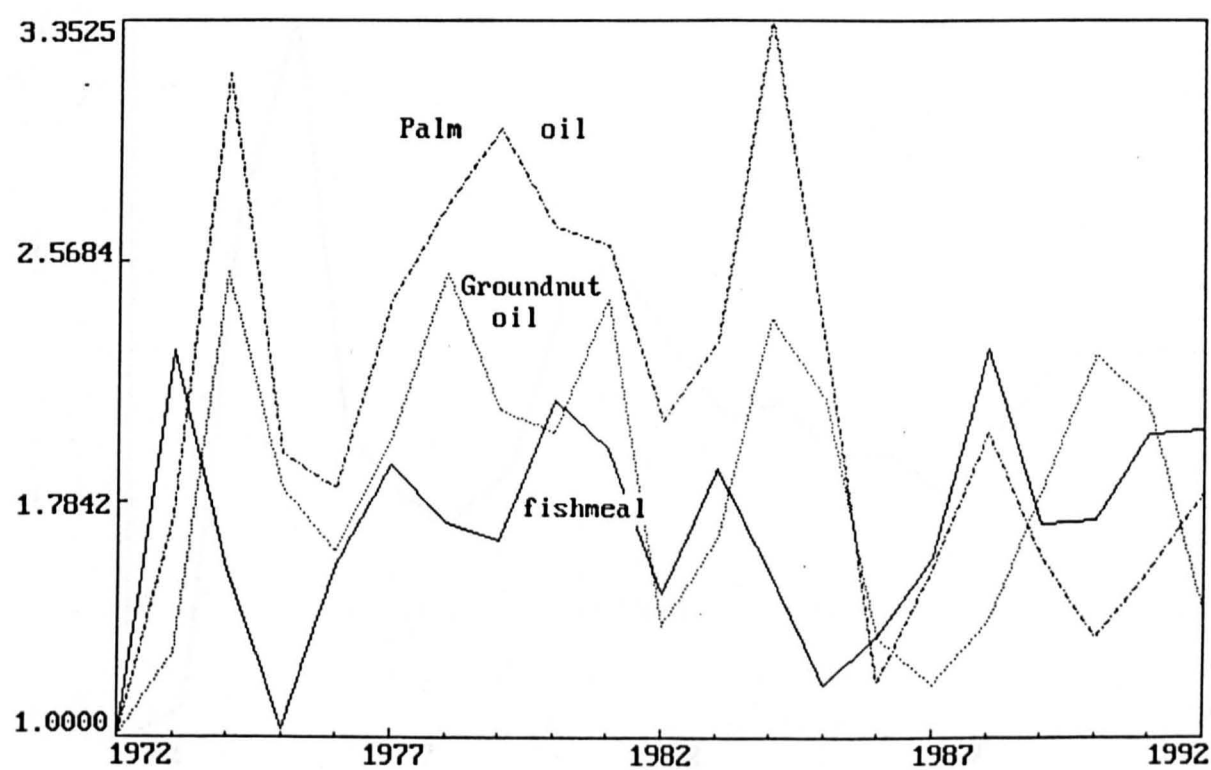
Cotton price had also an erratic behaviour during the period. The main changes occurred from the mid-1970's when the price soared to reach 77 US cents per pound in 1976 compared with 36 US cents in 1972, and then remained high until 1984. It fluctuated afterwards. Equally erratic was the price of fishmeal and groundnut oil. The latter undergoes on average a reversal every two years.

Fig 1.8: Commodity world market prices (1972 basis index)



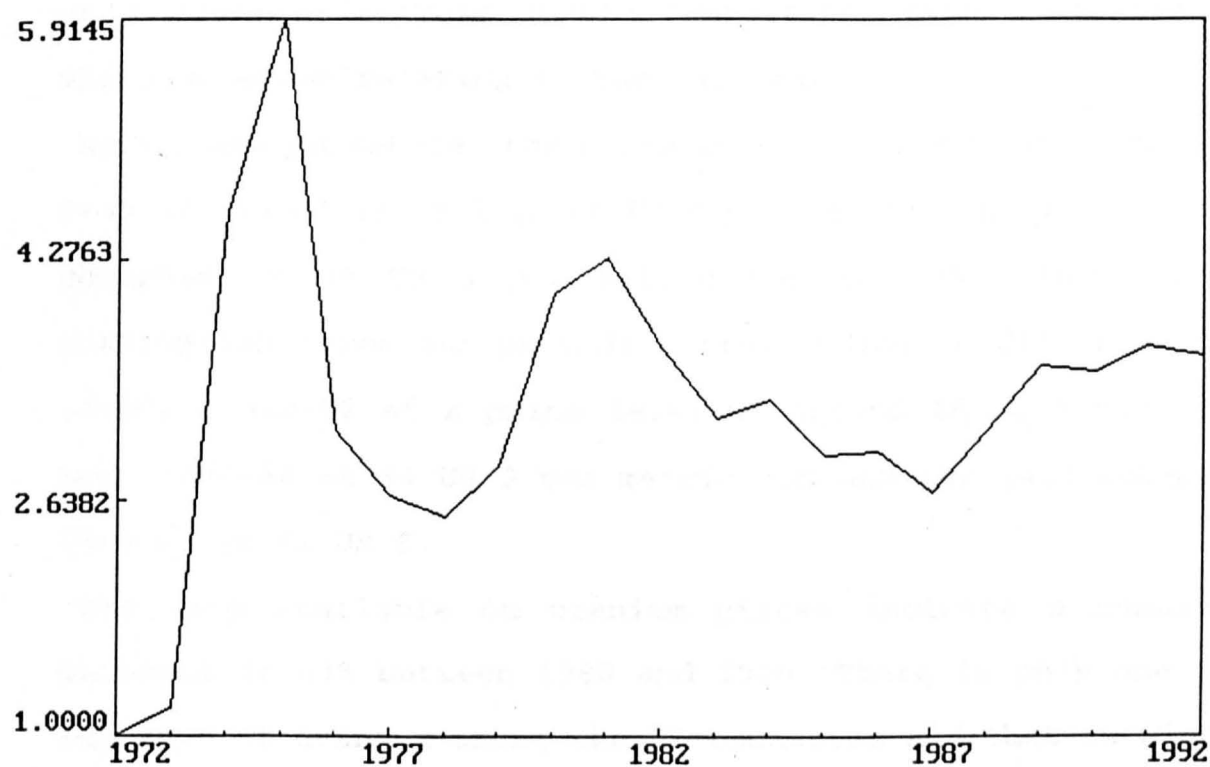
Source: IFS--IMF-Yearbook 1992

Fig 1.9: Commodity world market prices (1972 basis index)



Source:—IFS,—yearbook 1992

Fig 1.10a: Commodity price: phosphate



Source: IFS--IMF, yearbook 1992

The case of crude oil is of course well known, notably with regard its three-fold increase in 1974, the first oil crisis. The second oil shock occurred at the end of the 1970's and early 1980's. The price remained high until 1986 when it dropped by 50% at a level relatively stable thereafter, except for the rise which occurred relating to the Gulf War.

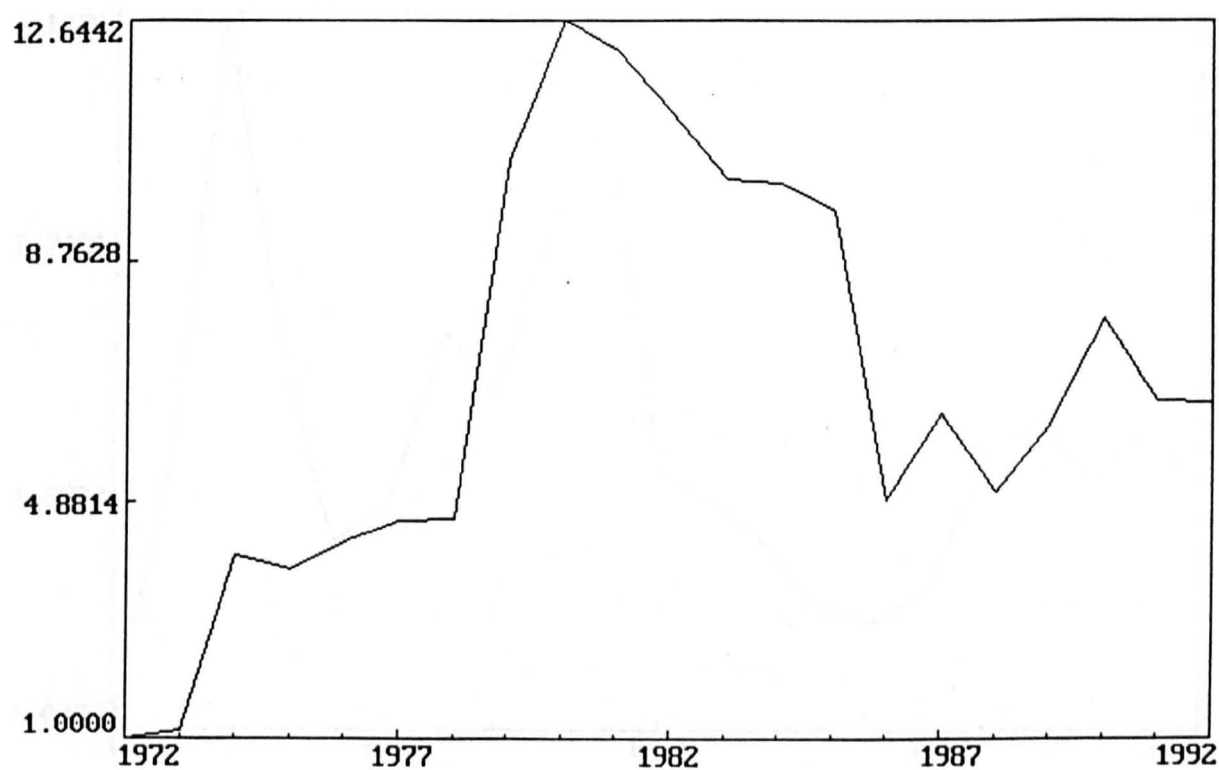
As for the phosphate, the price increased six-fold in two years from its level in 1972 to 68 US \$ per metric ton. It started to decrease to 29 US \$ per metric ton in 1978. Then one can distinguish three sub-periods corresponding to different price levels: 1980-82 at a price level of around 46 US \$ per metric ton, 1983-88 at 34 US \$ per metric ton and the last sub-period 1989-92 at 41 US \$.

The data available on uranium prices indicate a cumulative decrease of 63% between 1980 and 1990. There is only one major exporter of uranium among the FZ countries and that is Niger.

While the above commodities constitute export goods for the FZ economies, rice is an imported good, for the people living in town especially. Because rice represents a staple good, its price receives a great deal of attention. Important fluctuations characterized the period. The coefficient of variation for the rice price defined as the ratio between the squared root of the variance and the average value equals 0.296 during the period 1972-92.

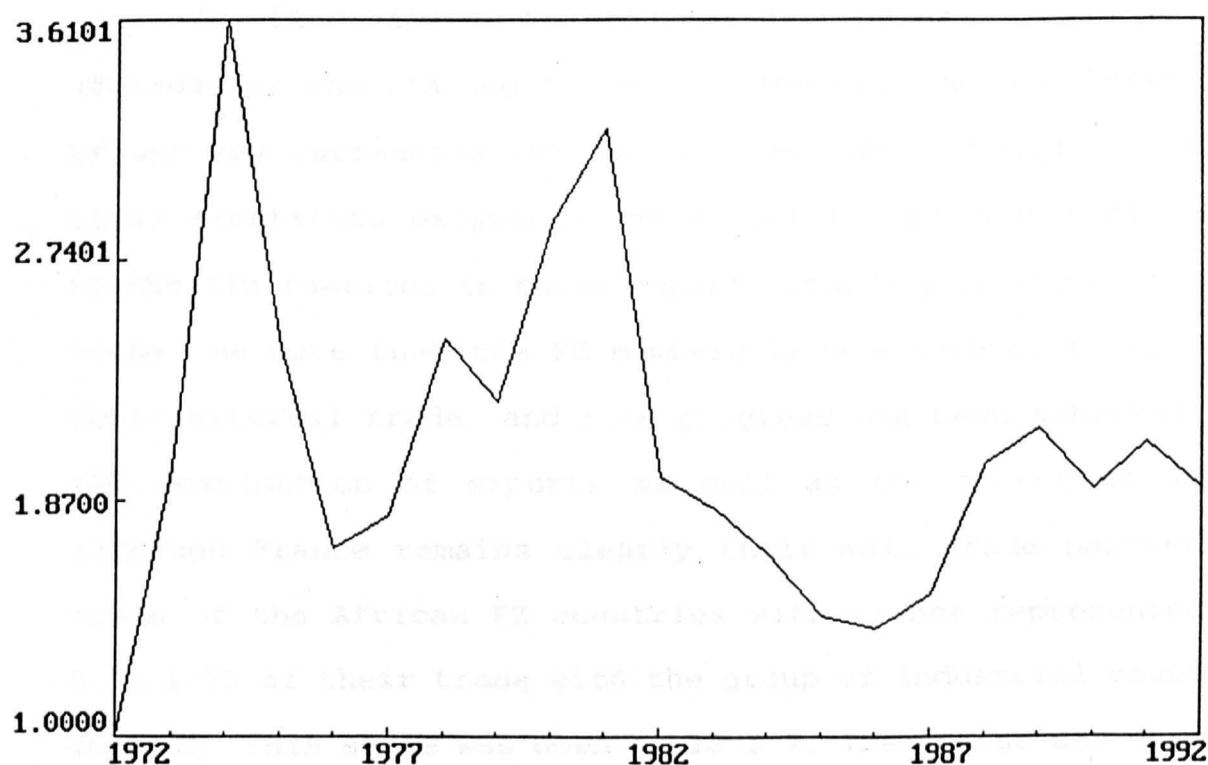
We can note that in terms of the coefficient of variation as an indicator of their variability, the following commodities appear as having the most volatile prices: cacao, coffee and phosphate and the less volatile are cotton, fishmeal and groundnut oil. The

Fig 1.10b: commodity price: crude oil



Source: IFS-IMF, -yearbook 1992

Fig 1.10c: Commodity price, rice



source: IFS--IMF, yearbook 1992

highest coefficient of variation (obtained with cacao price) and the lowest coefficient of variation (obtained with cotton price) are 0.424 and 0.195 respectively.

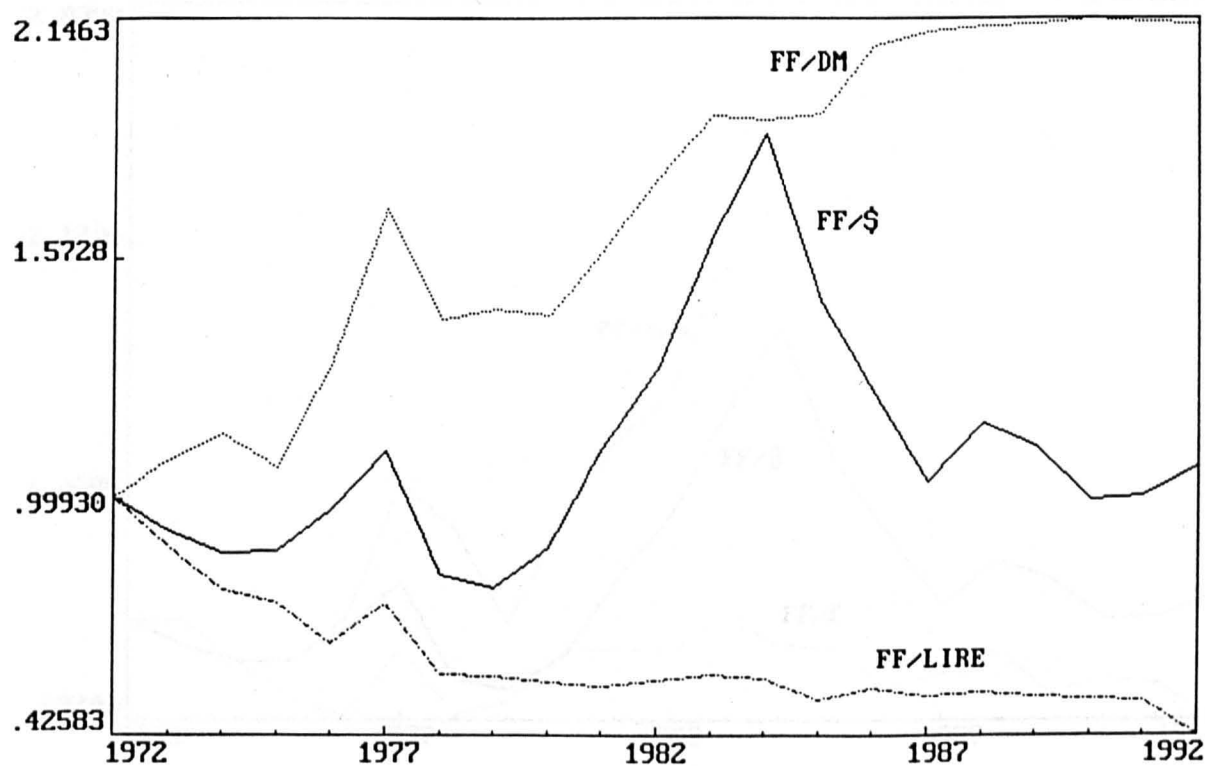
(ii) The fluctuations between key currencies

Because of the CFA peg to the FF, any fluctuations between the FF and key currencies (US dollar, yen, DM, £ pound and Italian lira) constitute exogenous shocks for the FZ countries similar to the fluctuations in their export commodity prices or terms of trade. We note that the FZ members have attempted to diversify their external trade, and some progress has been achieved about the destination of exports as well as the source of imports although France remains clearly their main trade partner. The trade of the African FZ countries with France represented 54.0 % in 1972 of their trade with the group of industrial countries. In 1992, this share was down to 38.5 %. The change has concerned more the exports than the imports. The share of France in the exports of African FZ countries started with 46.7 % in 1972 and decreased to 26.7 % in 1992. The share in the imports of the african FZ countries decreased much less from 60.4 % in 1972 to 52.2 %. The pattern of the relationships between key currencies matter for the FZ countries to the extent of this trade diversification.

Diagrams 1.11a and 1.11b show the fluctuations of the currencies with respect to the US dollar. The data show that significant variations happened all along, notably in the first half of the 1980's.

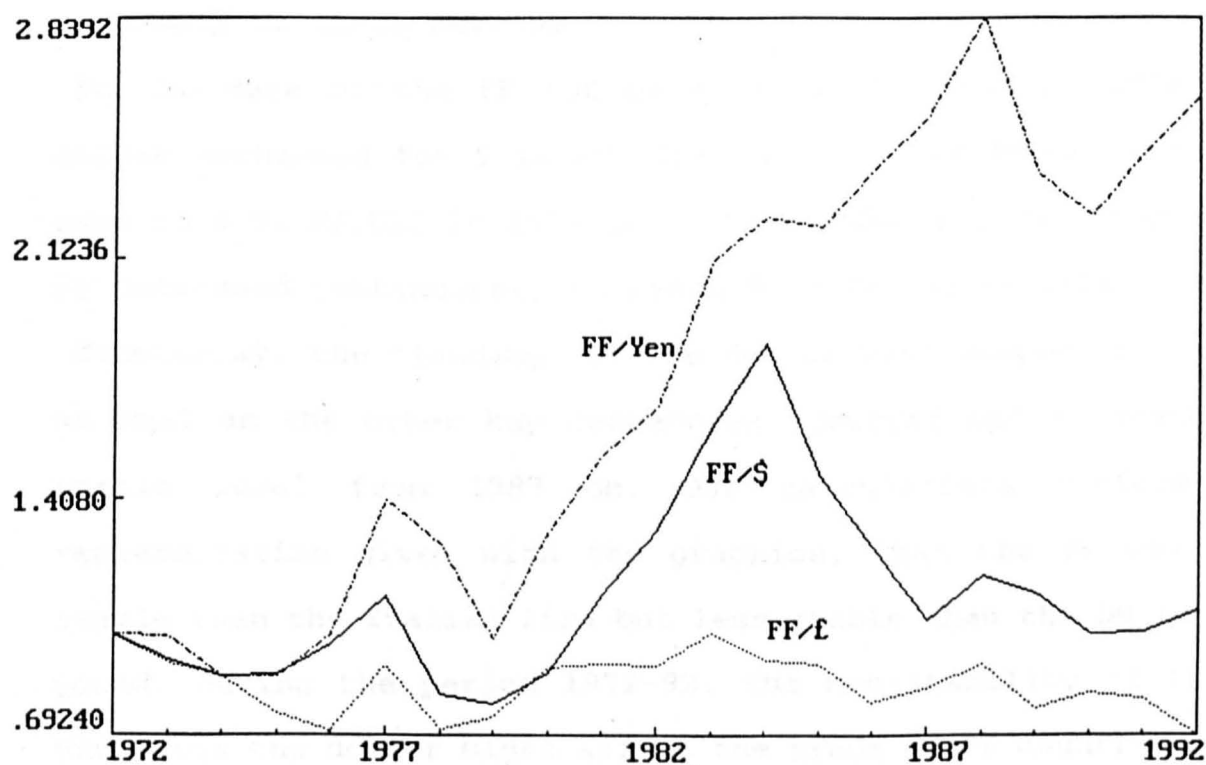
Actually from 1980, the European currencies started to

Fig 1.12: Exchange rate of FF with other currencies



Source: -IFS-/-IMF yearbook 1992.....

Fig1.13 Exchange rates



Source: -IFS-/-IMF ,yearbook 1992 - - - - -

depreciate vis-a-vis the US dollar, although the pound began a year later. Also the yen depreciated from 1979. This overall movement of the European and Japanese currencies reflects the rise of the American currency on all financial markets and which made many of these nervous.

In the case of the FF for example, at the end of 1972, one dollar exchanged for 5.12 FF. The value of the French currency rose to 4.71 FF/US\$ in 1977 and 4.02 FF/US\$ in 1979. From then, it decreased continuously to reach 9.59 FF/US\$ in 1984.

Eventually, the "landing" of the dollar with respect to the FF as well as the other key currencies occurred and it reached a stable level from 1987 on. Our calculations confirm the representation given with the graphics, that the FF was more stable than the Italian lira but less stable than the DM, and the pound, during the period 1972-92. The non-stability of the FF vis-a-vis the dollar might affect the trade of FZ countries with US. As for the other currencies, the behaviour of the FF seems to have been fairly well correlated with the Italian lira and the pound but not with the DM (except for the most recent period) and the yen, as can be seen from diagrams 1.12 and 1.13. The overall pattern of the fluctuations between the FF and the other currencies combined with a fixed peg of the CFA currency to the former again exposed the efforts for trade diversification of the African FZ member countries to considerable exogenous shocks regards the efforts for the diversification of FZ external trade.

(iii) The interest rates

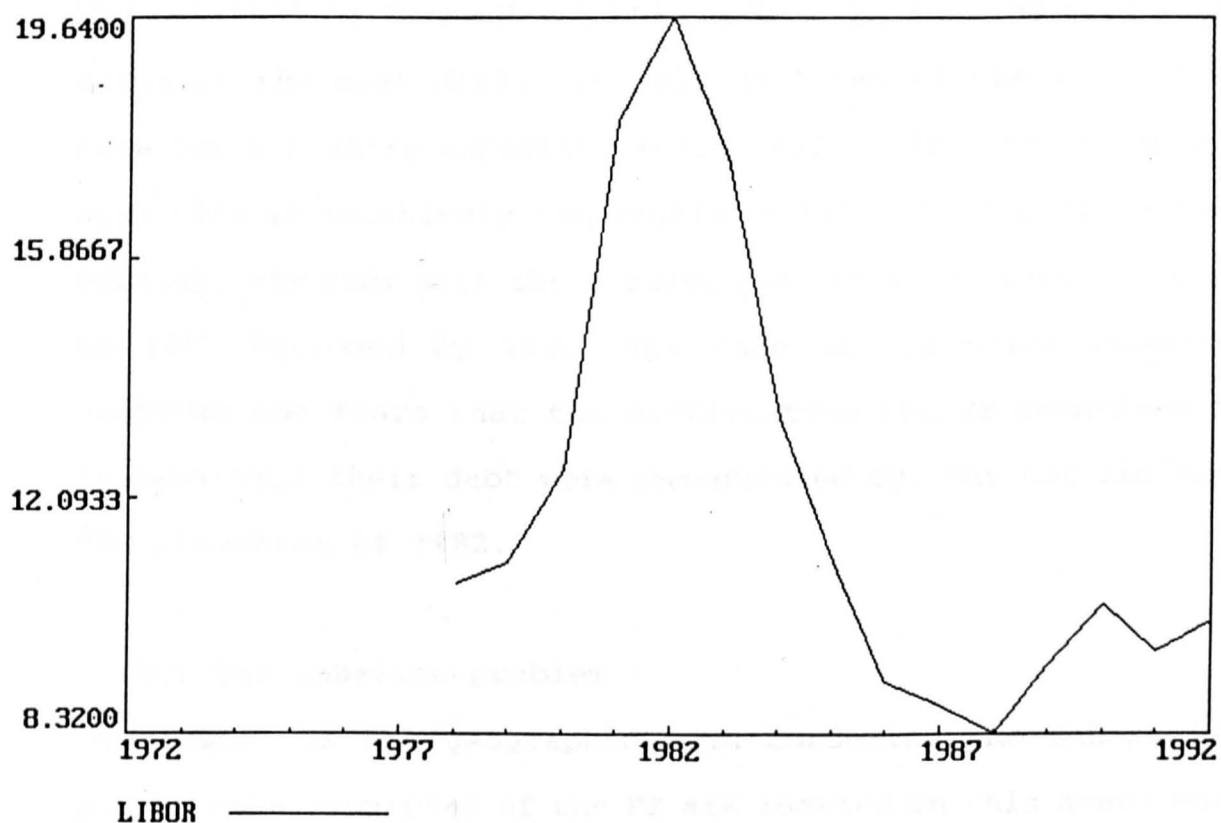
Like the other developing countries, the FZ countries suffered

from the debt problem, the causes of which are attributed to both internal and external factors by most analysts. One can see the extent of the difficulties by the fact that the FZ countries resorted largely to the Paris Club (nearly every year for most of them), to reschedule their debt with the donor countries.

The profile taken by the interest rates on the international markets played an important role in the advent of the international debt crisis. It is no coincidence that the year (1982) when Mexico failed to honour its debt, which triggered the crisis, was also the year when the six-month basis Libor (London interbank offer rate) reached its record level (see fig 1.14). In the years before 1982, the Libor kept rising from 10.75% in 1978 to 12.54% in 1980. It then increased sharply to 19.64% in 1982. A reduction followed, which in 1985 took the Libor back to the 1979 level. It holds true that the FZ countries receive a large part of their external capital inflows in the form of official development assistance. But for some of them a significant part their external borrowing included funds from private sources and export credits. In addition, the conditions of interest rate attached to official aid are related to the prevailing Libor. Indeed for a given element of grant, let us say 25% as this may characterize a typical aid package, the interest charges that the low income country bears will be affected by the conditions on the international financial markets since these represent the basis to determine the interest rate that the donor country will decide to offer, taking account of the grant element.

When assessing the effect of interest rates, some analysts go

Fig 1.14: Libor Interbank Offer Rate in % (FF)



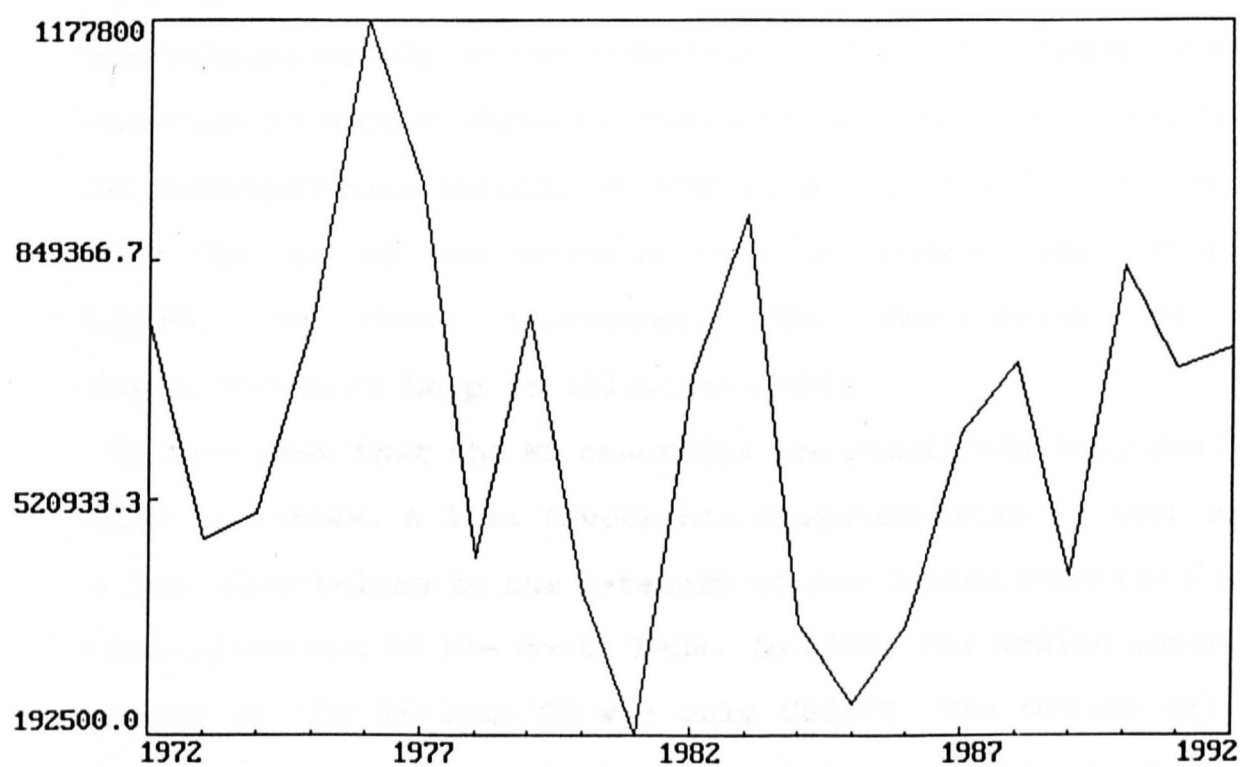
beyond the nominal rates to consider the real interest rates. These are derived using the commodity prices as a way to measure how the capacity of the debtor and commodity-exporting country will be influenced from one year to another by what happens on the external markets. Using this indicator, we find that 1982 was actually the most difficult year in terms of the real interest rate for a country exporting essentially coffee for example, but also 1992 is relatively comparable to 1982. For a cacao exporting country, the year with the biggest real interest rate corresponds to 1987 followed by 1982. The case of the other commodities confirms the fears that the difficulties the FZ countries faced in servicing their debt were inaugurated by, but not limited to, the situation of 1982.

(iv) The Sahelian problem

The Sahel is the geographic area bordering the Sahara in the south. Some countries of the FZ are located in this area: Burkina Faso, Chad, Mali, Niger and Senegal. The Sahelian area has the specific feature of erratic weather conditions. Very severe droughts occurred during the period under review, with their dramatic effects on the level of production in the agricultural sector and related sectors in these countries.

Let us take the case of Senegal for illustration. The harvests fluctuated considerably over time. The case of groundnut which constitutes the main cash crop for export is shown in fig 1.15. The surface of land used for this crop did not vary much. All of the trough levels correspond to years of drought, with the level of production falling to one third the normal level. As the

Fig 1.15: Production of groundnuts (Tons), in Senegal.



Source: BCEAO, -notes d'information

graphic shows, the drought phenomenon happened too frequently, nearly every two years on average.

c. The limits to internal deflation

The option for internal deflation in the FZ, that is the option for relying solely on the reduction in domestic expenditures, in choosing to adjust while maintaining the single currency peg at an unchanged rate instead of combining the expenditure reduction with the use of the exchange rate instrument, imposed a real burden on these economies. The description of some characteristics help to illustrate this.

We have seen that the FZ countries are relatively very small and open economies. A less favourable characteristic is that except a few, they belong to the category of low-income countries in the classification of the World Bank. In 1991, the median income per capita in the African FZ was only US\$390. The median value of other indicators give in 1990: an infant mortality of 111 per 1000 live births, a primary school enrolment of 59%. These figures⁷ on primary health and youth education, when compared with the situation in the early 1960's indicate that significant progress has been made in three decades. Nevertheless, it appears clearly that the situation remains fragile.

Some countries like Senegal started their adjustment programs as early as 1979. But most of the FZ countries entered the adjustment process later on, by the mid-1980's. In all cases except for one, the IMF and World Bank provided their assistance.

⁷ Source: Social indicators of development, 1993
World Bank

The exception was Burkina Faso which undertook its own adjustment at least until 1991 when the first agreement was reached between the Government and the Bretton Woods institutions.

On the basis of the data available⁸, we provide a brief illustration for five countries on the sub-period 1985-89. Calculations on the demand elements in nominal terms indicate that in four out of the five countries, the aggregate demand decreased. Only Senegal managed to increase its aggregate demand. We note that each country represents a specific case in the way the change in aggregate demand was broken down in the different elements: Government consumption, investment and private consumption. In Senegal, where the aggregate demand increased by 5% per year in nominal terms, the increase was 1.9% for Government consumption, 5% for investment and 5.6% for private consumption. In Cameroun, the aggregate demand decreased by 0.75% per year in nominal terms. This was the result of an 1.3% increase in Government consumption, a decrease of 0.1% and 1.2% in investment and private consumption respectively. Benin represents a strong bias to the detriment of investment and private demand. The Government consumption increased by no less than 10% per year while investments fell by 6.3% and private consumption by 1%. In Congo, it is the investment component which suffered the most, falling by 17.8% per year. The Government consumption decreased by 2.5% and private consumption changed little with a mere 0.3% increase. The Niger case presents some similarities with the Benin case. The Government consumption increased by 6.5% per year. The decrease in the aggregate was

⁸ Source: IFS/IMF yearbook 1992

brought about by the decline in investment and private consumption by 2.0% and 2.4% respectively.

The above results are presented as changes in nominal terms. When set in real terms and per capita, they leave no doubt on the effects of the economic crisis on the standards of living. For low income countries, deteriorating living standards of this scale represent real hardship. But this did not prevent the financial situation, that is, the overall balance of payments of each of these countries, to worsen without exception and some times dramatically. Or put in other terms, the adjustment although very painful had not gone far enough to reverse the balance of payments situation, given the dimension of the exogenous shocks.

If the above sample is well representative of the group, the FZ countries with a fixed peg of their currency can only cut their absorption to adjust and did it to a large extent. They faced the following dilemma: either to proceed with the adjustments and impose more hardship on the populations or face an immediate financial bankruptcy unless France and maybe other donors extend their financial support.

The data on the balance of payments indicate that despite the efforts of adjustment, the financial situation has deteriorated during the period. The overall balance of the African FZ countries as a whole showed a surplus each year between 1972 and 1978: the average surplus was 190 millions US\$ per year. For the rest of the period, the balance was negative each year and increasingly so. The average deficit of the overall balance started with 370 millions US\$ during the sub-period 1979-85. It

went up to 949 millions US\$ in 1986 and 2701.5 millions US\$ in 1987, and remained high for the rest of the period: an average of 3074.8 millions US\$ between 1988 and 1993.

The effect of the steep decrease in the commodity prices as occurred in the mid-1980's seems to have outstripped the efforts of adjustment. The description of the situation taking account of GDP gives a better idea of the financial imbalances. The surplus of the overall balance represented 5.7%. When the deficit appeared for the first time, it was 4.2% of GDP during 1979-85. The ratio increased to 7.4% in 1986, followed by a three-fold jump to 22.0% in 1987. It increased even further to 25.7% on average during 1988-93.

Here the context of the recent period differs from the situation in the early 1980's and before in the sense that it has become more and more difficult to administer the austerity programs. This is a new dimension resulting from a process of democratisation that the FZ countries have experienced more than ever before. Multiparty politics will necessarily mean more attention to the art of governing, with decision-making hopefully being based on the long term objectives on the one hand, but having to face the short run concerns on the other hand.

Conclusion

The exchange rate regime which characterizes the FZ differs from the usual type of exchange rate peg. The highlights given above have aimed at drawing this distinction. The number of countries involved, the historical dimension and the duration of the fixed rate all provide specific features to the FZ. From the economic

standpoint, the FZ appears mainly as a monetary union between a small economy (the group of African FZ members) and a large economy (France). This is a crucial point, and the framework used for the modelling exercise in the rest of the paper will basically reflect such a portrait.

A brief look at the functioning of the FZ has given an account of some questions about setting up a monetary policy in a multilateral context. The reforms which occurred at the end of 1973 represented an effort to improve and an act of correcting some imbalances in the system. The development objectives received a new emphasis besides the financial stability objectives which dominated the first period of the FZ experience. Also, the reforms brought about a reduction in the direct involvement of France in the management of the monetary institutions on the african side of the Zone. The present study corresponds essentially to the post- reform period. The use of the small/large country model is still justified however, since the reforms did not affect the exchange rate regime, known as the basic characteristic of the FZ.

The period of the early 1970's on had witnessed important developments on the international scene, which seemed to combine and put increasing strains on the system of the FZ. The end of the Bretton Woods standard of fixed exchange rates and the subsequent fluctuations between key currencies, the large commodity price variations and the high interest rates on the world markets set the contrast between an external environment highly instable and the rigidly fixed exchange rate CFA/FF. Where the Bretton Woods standard would have even recognized a

"fundamental disequilibrium" and allowed a change in the parity of the CFA currency, the FZ system failed to do so for many years.

Another source of strain comes from the option for Europe of France. This is certainly its natural choice. But the consequences might be to increase the frustrations on the african side of the Zone. The events which marked the last decade at least testify on the difficulty for France to reconcile the interests with regards the partners on either side.

Chapter 2: Literature on exchange rate regimes: a survey

Introduction

The study of exchange rate regimes has conveyed an extensive literature in the last 50 years since the Bretton woods System of fixed but adjustable parities was set up in 1944. Considering the period starting from the 1950's to the 1980's one can identify two major factors which had influenced this literature. One is the shift from the regimes of fixed exchange rate regimes to the regimes of flexible exchange rates in 1973 when the Bretton Woods System finally collapsed. For a long time, the analysis of international economics payed much attention to the determinants of the balance of payments. Indeed during the period of fixed rate regimes, the problem of external balance represented one of the main concerns of economic policy about the combination of the available instruments to obtain a delicate equilibrium both at the internal and external level. But the discussion on the alternatives to the Bretton system began long before 1973. One of the turning points in the debate can be traced back to Friedman (1953) and had certainly an important role in the advent of the flexible exchange rate regimes, which in turn led the literature since then to focus on the question of exchange rate determination instead of balance of payment determination.

The second major factor came with the idea of an economic union in the European context of the Common Market. The discussion on the specific issue of countries forming a currency area was

initiated by Mundell (1961) who asked when it would be optimal to form an optimum currency area. Two other key contributions followed soon with McKinnon (1963) and Kenen (1969). Still in the European context, a number of developments led the EC countries to manage their currencies inside predetermined bands, in a system of managed floating presently known as the ERM (exchange rate mechanism). The target zone literature (Miller & Krugman, 1992) has dealt with the modelling of this more recent European experience.

With regard to developing countries, the practice before 1973 was dominated by a fixed peg of their individual currency to a key currency (dollar, £, FF). When the Bretton Woods system ended, these countries started to consider alternative forms of exchange rate policy. Correspondingly, the literature raised the issue of optimal peg (Williamson, 1982) including the possibility of a managed float or a flexible exchange rate regime.

In what follows, we give a review of these main strands of the literature: optimum currency areas, optimal peg and target zone in sections 1, 2 and 3 respectively. The present review prepares more specifically for chapters 3 and 4 while the two chapters 5 and 6 will contain an introductory presentation of the relevant part of the literature.

2.1 Optimum currency areas

In defining an optimum currency area, the literature first referred to one specific economic characteristic. The approach then extended to a multicriteria analysis.

a. Mundell (1961): " A theory of optimum currency areas "

The paper starts with an observation about the implications of a shift in demand between two countries. When such a shift happens, the countries in question will face the problem of either unemployment or inflation. Is there an exchange rate formula to get round of the difficulty? In the fixed exchange rate case, the dilemma appears clearly: the balance of payments constraint requires the country which benefits from the shift in demand to inflate or alternatively the deficit country to deflate and suffer unemployment. The concept of currency area may define a fixed rate regime between countries which agree to sustain a fixed relationship between their currencies or it may describe a common currency situation. In the latter form, the difficulty still appears when the shift in demand occurs between two different regions of the currency area. A full employment policy at the level of the area would mean more inflation pressure. Similarly, a stable price policy will imply the acceptance of more unemployment.

Now let us consider the regime of flexible exchange rates. Then the problem of balance of payments does not arise any longer between the two countries which allow their currencies to adjust so that to maintain external balance. Nevertheless, the shift in demand may still cause concern. This can be seen with the example of two countries such as US and Canada. We may assume that the Eastern and Western regions are specialised in the production of goods 1 and 2 respectively in the US and Canada alike. Then in each country, the change in the relative demand for the two goods would raise the same difficulty described above, with a deficit region and a surplus region. The flexible rate regime ensures

that the balance of payment will be in equilibrium between the two countries but it does not solve the disequilibrium between the Eastern and Western regions that the shift in demand has created.

The problem can be solved, at least theoretically when the areas are drawn along the patterns of production and trade. Under the specialisation assumption, one of the currency areas will correspond to the Eastern region which produces good 1 and the second currency area will correspond to the Western region which produces good 2. The two regions sell to each other their excess supply of the two goods. A flexible exchange rate between the two newly defined currency areas will insulate each area from the disturbance on demand, ensuring both internal and external balance in the Eastern and Western regions.

In practice, of course the redefinition of national boundaries to fit the theoretical scheme of appropriate currency areas appears highly unlikely. But the argument has strong implications. It leads to the search for characteristics which could prevent the unemployment or inflation pressure situation from arising because of the disturbance on demand. An area within which such conditions exist will represent an appropriate currency area. The main case which comes to mind in this respect is factor mobility. If one takes a group of countries between which labor moves freely, an excess demand in one part of the area and an excess supply in another, both resulting from the same shock would tend to create inflationary pressure where excess demand exists and risks of unemployment where excess supply prevails. Responding to the emerging disequilibrium, labor

will move from the deficit country or area to the surplus country. This way, labor mobility, provided the move occurs quickly enough, will smooth out the inflation and unemployment pressures. In sum factor mobility draws the dividing line between a currency area to be characterized by internal labor mobility and the rest of the world, labor being essentially immobile between the two. One may note also that the argument bears on the stabilization issue following a shock.

b. McKinnon (1963): "Optimum currency areas"

This contribution can be placed in the direct continuation of the work by Mundell on optimum currency areas in the sense that it seeks to identify another economic factor (other than labor mobility) which may play a significant role in the definition of an optimum currency area. The factor in consideration here is the degree of openness. A given economy is said to be open to the extent of the ratio between its tradable goods and its non-tradable goods. The higher the ratio, the more open the economy by definition, and vice versa. The aggregate variables to consider for the measure of how relatively important are the tradable goods might be the domestic production or consumption of the economy in question.

Ensuring internal and external balance remains the concern for the authorities. But the distinction between the tradable and non-tradable sectors helps to emphasize the way inflation will be affected by the exchange rate policy. Let us consider the same type of shocks as in Mundell (1961), that is a shift in demand for the tradables. The resulting trade imbalance needs to be

corrected in a way or another. If a combination of monetary and fiscal policies can suffice to bring about the necessary adjustments within the currency area with little costs compared with the use of the exchange rate tool, then the currency area can be considered as optimal. Conversely, if changes in the exchange rate achieve better the internal and external balance, then one should recommend a flexible exchange rate between the countries instead of regrouping them in a currency area.

Modelling the case of a small economy, the conditions under which the fixed rate regime dominates correspond to a high degree of openness. Indeed, in this case, a change in the exchange rate will translate in an equivalent change in the price of the tradables and since these goods represent an important share in the economy and in the typical bundle of goods on which the representative consumer spends for his consumption, money illusion can hardly prevail. The domestic price will vary as a consequence. In comparison, a small change in the monetary and fiscal instruments might be enough, given the size of the tradable sector, to absorb the trade imbalance without causing much unemployment and without affecting the domestic price.

In contrast, a flexible exchange should be chosen if the ratio of tradable/non-tradable is rather low. One needs to consider the same trade imbalance in an economy with a small tradable sector. The monetary and fiscal action would be more important to restore the external balance, everything else being given. The non-tradable good sector and the internal balance bear the consequences of the action. On the other hand, the change in the exchange rate necessary to offset the trade imbalance will affect

the price of the tradables. But because the price of these goods have little effect on the domestic price, the adjustment required will be reduced to that extent if one resorts to a flexible exchange rate.

One can note that throughout, the analysis keeps the assumption of given terms of trade, compatible with the consideration of a small economy. Also, the justification of putting an emphasis on price stability seems to be that this stability will be synonymous of currency liquidity and of efficient allocation of resources.

c. Kenen (1969): " The theory of optimum currency areas: an eclectic view"

The paper recognizes the merits of the seminal work by Mundell (1961). The consensus is that perfect labor mobility between a group of countries would define that group an optimum currency area. Only minor objections could be raised on this main result. They relate to the differences which may exist in labor intensities among industries across countries of the currency area and which may cause "residual" unemployment after the expected move of labor takes place following a shift in demand. Also the perfect link between labor mobility and balance of trade adjustment as implicit in the argument that labor mobility will ensure optimality cannot be guaranteed as a matter of fact. Other qualifications might be called for in consideration of the behaviour of investments or the extent to which the fiscal and monetary policies support each other through coordination.

Kenen's main argument results from the doubt about the

usefulness in practice of the optimality definition based on perfect labor mobility. He puts forward an alternative criterion, namely, the product diversification of a given economy. The main points can be made with respect to this criterion. First the more an economy is diversified, the less it will face terms of trade disturbances since the independent shocks on the different products will tend to average out, according to the statistical property known as the "law of large numbers". For the same reason, a well diversified economy will suffer less unemployment than a non-diversified economy when faced with an adverse shock on terms trade.

To make the second point more explicit, the author develops a model to handle different configurations: small economies versus large countries on the one hand and diversified economies versus non-diversified economies on the other hand. In the cases of shocks taking the form of shifts in demand, the results derived from the model indicate that under a flexible exchange rate the diversified economy will experience less variation of the exchange rate to restore equilibrium than the less diversified economy, whether it is a small country or a large country, in other terms the fixed exchange rate regime will prove more cost effective in terms of unemployment for the diversified economy than the less diversified economy.

Considering another category of shock in the form of differential increase in money wages at home and abroad, one obtains the following result that no difference exists between the diversified and non-diversified economy in the case of a flexible exchange rate. In the case of a fixed exchange rate, the

diversified economy will stand better the shock and confront a less severe problem of unemployment than the non-diversified economy. But this result holds only for the small country case.

The policy implications point to the adoption of a fixed exchange rate for a developed , diversified economy. However, it will remain the difficulty which will arise with the monetary shocks. The suggestion is to resort to an appropriate combination of monetary and fiscal policies to handle this category of shocks. In contrast, a less developed non-diversified economy had better choose a flexible exchange rate.

Kenen's paper together with Mundell's and Mc Kinnon's represent the most distinctive pieces of work on the theory of optimum currency areas.

At that time the debate about monetary integration in Europe was part of the discussion. This is reflected not only in Mundell's paper but also in Johnson (1971) and Fleming (1971). Johnson's paper stresses that the crucial factor for a successful monetary union will be the closeness of national policies and attitudes towards inflation and/or unemployment. This introduction of the political dimension is also echoed in Corden (1972) while drawing a distinction between a complete monetary union and a pseudo-monetary union. Fleming (1971) underlines the risks of "fundamental disequilibrium" in a unified exchange rate system, the presence of divergent relative costs and trade-offs inflation/unemployment. Ishayama (1975) notes the limits of the traditional approach based on one economic characteristic and points to the need for a multicriteria , cost-benefit analysis. Also he considers the difficulty to reconcile McKinnon's and

Kenen's criteria. But the new approach raises itself another difficulty, that is how to measure costs and benefits and how to weigh them. On the conditions for a sustainable currency area, Presley & Dennis (1976) observe that in addition to the convergence in national inflation rates, other important conditions include similarity of price and income elasticities as well as the structure of external trade partnerships with the rest of the world outside the area.

2.2 Optimal peg

This section will consider some contributions of the optimal literature before looking at three other contributions more specifically directed at the FZ case. We will draw in part from Williamson (1982) which provides a survey of the literature on optimal peg.

While the key currencies were in fixed rates to each other along the rules of the Bretton Woods system, the developing countries in general pegged their own currency to one of the key currencies. When the international monetary system shifted to flexible exchange rates, these countries faced the decision problem about the type of exchange rate policy to adopt. Continuing with the old peg became less attractive but the alternative of literally free float exchange rates appeared to be beyond their capacities in most cases, due to the thinness of the exchange markets and the presence of a potentially huge exchange market pressure. The "managed" float either in the form of an adjustable peg or in another form seemed to provide an affordable, probably more suitable to the new environment.

a. In general

The question is discussed extensively in Black (1976): "Exchange policies for less developed countries in a world of floating rates". For the authors, there is a reason why the less developed countries did not shift to the generalised float as did the developed countries. A number of weaknesses seem to characterize the financial and money markets in less developed countries. Domestic securities are little substitutable to foreign securities, which will explain that modifications in the money-market conditions will have asymmetric effects at home and abroad. The thinness of the market for domestic securities has therefore the effect of segmentating the financial market. This fragmentation plays against the domestic market which appears vulnerable to speculative waves with the destabilizing risks they may have. The non-existence of forward markets in general means that there will be less capital mobility and the burden of adjustment will bear on the spot exchange rate following disturbances in the exchange market. A small size of the financial market worsens the situation of asymmetry that the small country stands with regards the large country.

The author chooses domestic price variability as the criterion upon which the exchange rate policy will be based in the stabilisation effort when facing internal and external shocks. The domestic price is meant to represent the price of tradables in domestic currency, and consequently by the PPP relationship it corresponds to the effective exchange rate between the domestic currency and the other currencies since the price of

tradables in foreign currency are assumed to be given. The domestic price variability will amount to the variability of the effective exchange rate. The analysis is carried further on the basis of a model constructed to fit the situation of less developed countries. These are generally small open economies. The model therefore belongs to the tradition of the dependent economy model with the consideration of a two goods economy: one tradable and one non-tradable. The tradable is chosen to correspond to a composite of exports and imports.

Since the focus will be on the effective exchange rate, the problem of choosing the weights arises. The recommendations point to the use of trade data on exports to, or imports from, the trading partners or even the average of exports and imports. The relevant data may generally be computed on the basis of direction of trade although the alternative basis of currency denomination may require some attention in specific cases.

A priori, the alternative exchange rates to choose from include free floating, managed floating, single currency peg and pegging to the SDR (Special Drawing Rights). The managed floating in fact is meant to be the same as a basket peg with possibly the continuous depreciation or appreciation to allow for inflation differentials. One can distinguish two types of single currency peg, depending on whether the peg operates exchange controls, import quotas or similar restrictions or whether the defence of the single currency peg uses reserves either from the existing stock or from external borrowing. The comparison of the costs and benefits in these different cases starts with an evaluation rejecting the type of single currency peg which resorts to

exchange controls since it leads to crude misalignment and misallocation of resources, and results very often in the development of black markets and in forced large devaluations and consequently high variability in the exchange rate. This represents excessive costs compared with gains from not holding reserves.

The other type of single currency peg prevents these costs but it will require more commitment to government budget discipline and related lines of action, otherwise the costs in terms of reserves depletion or external borrowing will become soon unsustainable. Calculations to minimize the variance of the effective exchange rate indicate that if this type of single currency were to be adopted, it should relate to the key currency of the large country which demonstrates that its currency displays both low variance for itself on the one hand and high covariance with the other key currencies on the other hand.

An improvement on this regime might be obtained with a basket peg which aims at stabilizing the effective exchange rate, at least by reducing the variance of the effective exchange rate. The managed float or basket peg typically will respond to external shocks by changing the exchange rate (with respect to the intervention currency) and to internal shocks by keeping the exchange rate unchanged. In addition to reducing the variance of the effective exchange rate, the basket peg presents some other advantages in terms of reserves holdings with respect to the single currency peg.

The comparison puts in theory the free float in the position of belonging to the alternative regimes to choose from. But the

prerequisites for the free float more than in the other cases include investments to develop an enabling financial market with in particular the existence of a forward market.

The other contributions include Crocket & Nsouli (1977), Flanders & Helpman (1979) and Lipschitz (1979). As noted by Williamson (1982), these different papers on the optimal peg seem to share the common view that the exchange rate fluctuations between third currencies represent disturbances the domestic (small open) economy need to be protected from. So all is about to stabilize the economy. Understandably, the focus bears on one or another aspect about the state of the economy. But it more or less easy to relate each of them to the concern of internal balance, external balance or resource allocation and/or income distribution. This has raised the question of which macroeconomic variables the exchange rate peg might affect in the first place. Differences of views appear on this point, about the terms of trade for example as well as on the models constructed. On the problem of the weighting method to choose for the peg, the recommendation for (total) trade weights emerges as the most favoured. But these papers have in a sense bypassed a number of operational issues (e.g. averaging method in the basket peg, quotations and other procedures) as indicated in Takagi (1988).

b. Contributions on the FZ

The existing literature on the FZ can be divided into three main components. The first one which dominated at the beginning dealt with the "evaluation" of the economic performance of the member countries. The concern was to assess the achievement the FZ

countries as a group were obtaining in terms of output growth, inflation, trade balance etc... In this evaluation, the neighbouring countries or even the other developing countries may serve as a control group. Among the papers which belong to this category, there are Devarajan & de Melo (1987a), Guillaumont & al (1988) and Lane & Page (1991). The second category of studies such as Devarajan and de Melo (1987b) related to shock analysis to see how the FZ behaved in face of shocks. But the assumption was maintained that the stabilization would be implemented taking the fixed parity of the CFA currency as given. The third category took up the shock analysis and at the same time sought to assess the optimality of the single currency peg. The latter category has retained our attention and includes the three following papers: Nascimento (1987), de Macedo (1987) and Devarajan & Rodrik (1991).

The observations on the above three studies specifically on the FZ will include elements of the debate between de Macedo and Nascimento⁹ and additional remarks. Although using quite different frameworks, the two authors obtain results which relate specifically to the question of to what extent the FZ countries undergo an "automatic external adjustment" or alternatively their reserve losses are sterilized by a transfer from the large country to the small country. The answer given to this question is different, and the explanation will be sought in some features of the two models which have been pointed to as source of the divergence: PPP assumption in the Nascimento's model and use of

⁹ See "The political economy of risk and choice in Senegal" ed J. Waterbury & M. Gersowitz (1987).

export or import weights instead of total trade weights in the Macedo's model. Some doubts are also cast relating to the result on the one hand by Nascimento of the crawling peg being less optimal than the fixed peg and on the other hand among the findings by de Macedo the existence of the monetary rule and significance of the transfer.

These observations have some bearing on the scope of the results obtained. In addition, one might point to the fact that both studies did not deal explicitly with the terms of trade. Also the comparison was limited to a few exchange rate regimes, in particular in de Macedo (1987) which in fact focused on the single currency peg and its implications with respect to the basket peg. The latter remark applies to the paper by Devarajan & Rodrik (1991). Furthermore as noted by the authors, the study has bypassed some important benefits such as the currency liquidity. In contrast to the other two papers however, this one has an explicit treatment of the terms of trade. But the model as specified does not include money shocks and in addition the empirical analysis relies on some control of the inflation differential. This seems to be an imperfection of the model. While the non-inclusion of money supply shocks may not be an important omission for the FZ countries, it is when comparing these with other experiences of flexible exchange rate regimes. In addition, the home-good price is not affected by the terms of trade as a result of the specification by the authors. Otherwise, the price index of the home-good would not be constant in a fixed rate regime as they assume.

The three models represent an immense contribution to the

understanding to the experience of the FZ countries and the implications of the fixed exchange rate regime: they represent a significant step in modelling the FZ experience, notwithstanding the possible shortcomings as pointed out. The next chapters will aim at carrying further the modelling exercise, taking into full account of both money and terms of trade shocks. But before coming to that stage, we will present another relatively recent strand of the literature, namely the target zone.

2.3 Target Zone

The literature on exchange rate economics has witnessed a number of developments in the recent period. Among these, one can mention the features of the modern asset view and rational expectations as exposed in Frankel (1983) for example, as well as the target zone presented in Krugman & Miller (1992).

Some models of exchange rate determination used to take, along the traditional view, the trade flows for the main explanatory factors. But the alternative approach according to which the exchange rate is an asset price determined by the relative supply of, and demand for, money came to prevail. Indeed, the size of international capital flows more and more proved to be far higher than the amount related to trade transactions, thus giving a strong support to the modern analysis. But it is worth mentioning much less support came from empirical testing. Haacche & Townsend (1981) and Meese & Rogoff (1983) indicate the little success obtained when testing this mainstream framework of exchange rate determination.

The asset approach itself includes two main ramifications: the monetary model and the portfolio model. Their difference results from the assumption about the relationship between domestic and foreign funds. The former assumes perfect substitutability and uncovered interest rate parity while the latter allows for imperfect substitutability and the existence of a forward risk-premium.

The target zone literature has built upon the monetary model and has used stochastic calculus, with the aim of documenting exchange rate regimes such as the EMS or experiences of regime shifts such as the return of Britain to the Gold Standard. It has developed quite rapidly since the idea was launched in the mid-1980's. In what follows, we intend to give a presentation of the main features of the target zone model also known as the currency band model. Two versions of the currency band model exist, one based on the flexible price monetary model and the other on the sticky price monetary model.

a. Flexible price and currency band model

With regards the first category to start with, the canonical form is given in Krugman (1991). In this representation, the determination of the exchange rate (spot rate), takes the form of a simple equation in which the first two terms represent the money supply and the other relevant macroeconomic variables. A third term denotes the speculative component in the spot rate and is proportional to the expected depreciation of the currency. Typically, the equation may take the form:

$$S = m + v + \lambda E(ds) / dt \quad (1)$$

where S is the spot rate (domestic currency price of foreign currency), m the money stock and v the other fundamentals while λ can be interpreted as the interest rate semi-elasticity of the demand for money. The notation $E(dS)/dt$ stands for the expected depreciation on the basis of the information available at time t .

The model also specifies the way the fundamentals behave. Usually it is assumed that they follow a stochastic process in the form of a Brownian motion process, that is the corresponding in continuous time setting of a random walk in discrete time:

$$dv = \eta dt + \sigma dz \quad (2)$$

where η and σ are parameters (η is the drift and σ^2 the variance) and dz represents a standard Wiener process with $(dz)^2 = dt$. When $\eta = 0$, we refer to k as a Brownian motion process without drift. Other alternative forms of equation (2) exist, for example the case of a mean reverting process which is deemed to prevail in a context of significant interventions to keep the exchange rate or correspondingly the fundamentals around a given level v_0 :

$$dv = -\mu(v-v_0)dt + \sigma dz \quad (3)$$

where the parameter μ is a measure of the speed at which the adjustment operates.

Before going further, let us emphasize the rational expectations feature of the model by writing an equivalent form of equation

(1):

$$S = \frac{1}{\lambda} \int_t^{\infty} e^{-\frac{(t-\tau)}{\lambda}} E(k(\tau)) d\tau \quad (4)$$

where $k=m+v$ represents the fundamentals in general. The expression (4) presents the exchange rate as the present discounted value of expected future fundamentals. Also one can note that equation (1) appears as the reduced form of the flexible price model:

$$m-p = \alpha y_0 - \lambda i - v \quad (1)'$$

$$S = p - p^* \quad (1)''$$

$$E(ds/dt) = i - i^* \quad (1)'''$$

with the familiar notations of variables in logarithms:

m : money stock

v : velocity of money demand

p and p^* : domestic and foreign price indices

i and i^* : domestic and foreign interest rates

y_0 : full employment output

The equations represent the money market equilibrium, the purchasing power parity and the financial market arbitrage respectively. One needs only to normalize $y_0=p^*=i^*=0$ and substitute both (1)'' and (1)''' into (1)' to obtain equation (1).

Let us consider the three exchange rate regimes of fixed rate, free float and currency band to see how they can be derived from the same equation (1) (one might consider equivalently equation 4). The fixed rate does not raise any difficulty. It means that

equation (1) reduces to:

$$S = m+v$$

To keep the exchange rate unchanged, the monetary authorities will respond to a change in the fundamentals v by modifying the stock of money so that $m+v$ remains constant. In diagram 2.1, the fixed rate regime can be represented by the point A.

To determine the solution for the free float, we have also $E(dS/dt) = 0$ if there is no trend in v for the reason this time that when driven by the Wiener process, the exchange rate is as likely to increase as to decrease. Consequently the exchange rate takes the form:

$$S = m+v$$

In diagram 2.1, it corresponds to the 45° line FF. In case of a stochastic process with drift like in equation (2), the solution for the free float becomes:

$$S = m+v+\lambda\eta$$

With regards the currency band, the monetary policy will consist of keeping the exchange rate between a maximum value S_M and a minimum value S_m . We assume that the monetary authorities will intervene to keep the exchange rate inside the band every time it gets close to one of the edges. Inside the band however, the exchange rate and the fundamentals are let free to move. In particular the fundamentals will move according to equation (2). The band will be referred to as fully credible if these policy actions succeed.

For the solution of the currency band model, we can consider the family of functions $S(m+v)$ which satisfy equation (1) and apply

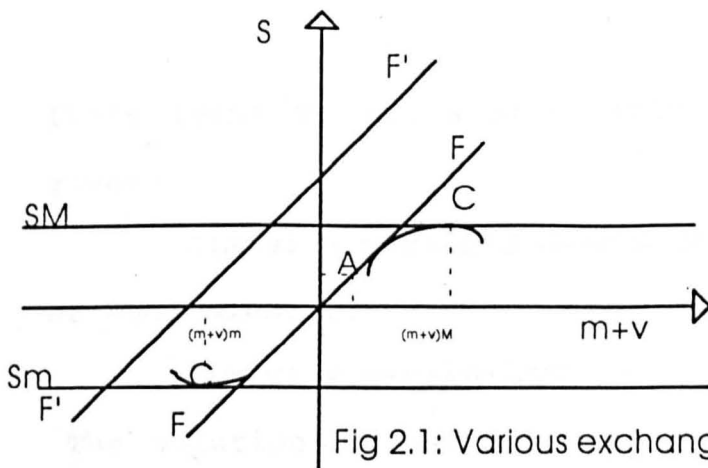


Fig 2.1: Various exchange rates

A: fixed exchange rate

FF: free float without drift

F'F': free float with drift

CC: currency band

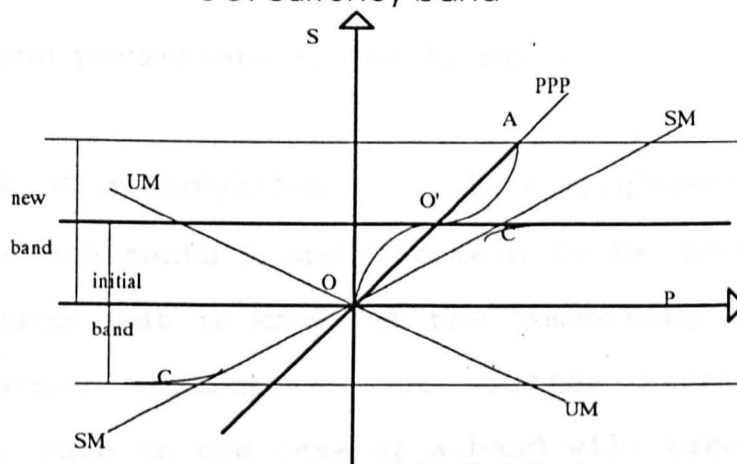


Fig 2.2: Nominal band and exchange rate rule

SM: Stable Manifold

CC: Smooth pasting condition

OO'A: Realignment rule

Ito's lemma to set a stochastic differential of $S(m+v)$. This gives:

$$S(m+v) = m+v + \lambda E(S' dv + \sigma^2 S'' dt/2) / dt$$

or equivalently:

$$S(m+v) = m+v + \lambda \eta + \lambda \sigma^2 S'' / 2 \quad (5)$$

The solution of these differential equations can be shown to have the form:

$$S(m+v) = m+v + \lambda \eta + A e^{\frac{\lambda_1}{\sigma^2} (m+v)} + B e^{\frac{\lambda_2}{\sigma^2} (m+v)} \quad (6)$$

where the parameters λ_1 and λ_2 equal:

$$\lambda_1 = (\eta^2 + 2\sigma^2/\lambda)^{1/2} - \eta \quad \lambda_2 = -[(\eta^2 + 2\sigma^2/\lambda)^{1/2} + \eta]$$

But the constants A and B remain to be determined. They will result from what is known as the "smoothing pasting" conditions or tangency conditions (not written here). This means the exchange rate in the case of a band will take a S form as shown in diagram 2.1 for the non-drift case.

With regards the S-shape, two points need to be clarified. First, one can observe that as the spot rate gets closer to the edge at which the interventions occur, the distance between the free float line and the S-curve increases. This is due to the way the state of expectations modifies according to the relative position inside the band. Near the upper edge for example, the agents in the financial market know that a move of the exchange rate downwards would go freely but a move leading outside the band will be resisted by the monetary authorities in the case of a credible band. The increase is likely to be less than the decrease, and on average the exchange rate is expected to be

lower than the level in the free float. By extension, this holds true though to a lesser degree towards the middle of the band. The same procedure applies when the spot rate gets near the lower edge.

Secondly, the tangency between the exchange rate and each of the upper and lower limits appears necessary since from an arbitrage point of view a kink would provide an infinite rate of return to speculators. This corresponds to the concept of "higher order contact" in optimum pricing theory.

The S-shape of the solution for the exchange rate implies that towards the upper edge $S'' < 0$ so that the interest rate differential is negative, and conversely towards the lower edge.

We note also that the exchange rate in the target zone is more stable than in the free float from the fact that the S curve everywhere lies flatter than the 45° line, although Flood & Garber (1992) find that this is at the expense of raising the interest rate variability.

One can note the very stylised characteristic of this model. One of its limits compared with the experiences in the ERM for example is that it assumes infinitesimal interventions and these interventions occur only at the edges of the band. Flood and Garber consider the case of discrete interventions and attempt to present the tangency condition as the limit towards which smaller and smaller interventions would lead. Furthermore, the model does not cover the cases of realignments as analyzed by Bertola & Svensson (1993) or the question of time dependency addressed in Ichikawa, Miller & Sutherland (1992).

b. Sticky price and currency band

Miller & Weller (1991) derive this model by considering that the domestic price is not flexible as in the model described above but adjusts slowly enough to cause changes in the real exchange rate. Also the full employment assumption is dropped. The analysis looks at the implications of a real band or target zone as well as of a nominal band. It uses as in the flexible price currency band model, a continuous time setting and stochastic calculus.

(i) Stochastic Dornbusch specification

The representation consists of five equations describing the LM and IS curves, the currency arbitrage, the price adjustment formula and the inflation expectations respectively:

$$m-p = \alpha y - \lambda i \quad (7)$$

$$y = -\gamma(i-\pi) + \eta(S-p) \quad (8)$$

$$E(ds) = (i-i^*)dt \quad (9)$$

$$dp = \phi y dt + \sigma dz \quad (10)$$

$$\pi = E(dp)/dt \quad (11)$$

The variables are logarithms and the notations are relatively familiar:

m : money supply

p : domestic price

y : actual output

i and i^* : domestic and foreign interest rates with i^* normalised to zero

π : expected rate of inflation

All the parameters are deemed positive. We note the introduction

of the actual output as a function of the real interest rate and the real exchange rate (competitiveness) in equation (8), and the price level which adjusts to the level of output with an additional term σdz corresponding to the (supply) shock in equation (10).

This specification, specially by means of equation (10) deals with the "overshooting" case and the realignment rules (see fig 2.2 to 2.4). There is no explicit solutions however. Only qualitative features are available.

Conclusion

The discussion on flexible versus fixed rate regimes took another step with the theory of optimum currency areas as launched by Mundell (1961): this theory attempts to identify an economic characteristic, typically labor mobility along which to define an optimum currency area. Mc Kinnon (1963) and Kenen (1969) gave contributions in the same sense, but putting forward instead the criteria of degree of openness and product diversification respectively. Other contributions include Johnson (1971), Fleming (1971), Corden (1972), Ishayama (1975) and Presley & Dennis (1976).

Most of the arguments developed by the theory of optimum currency area such as factor mobility show the limits of the FZ as an union between a large and small country. But the FZ portrait has also the important characteristic of a small economy pegged to a large economy. This leads us to consider the optimal peg literature. The work by Black (1976) gives a good representation on this part of the literature. The set-up is that

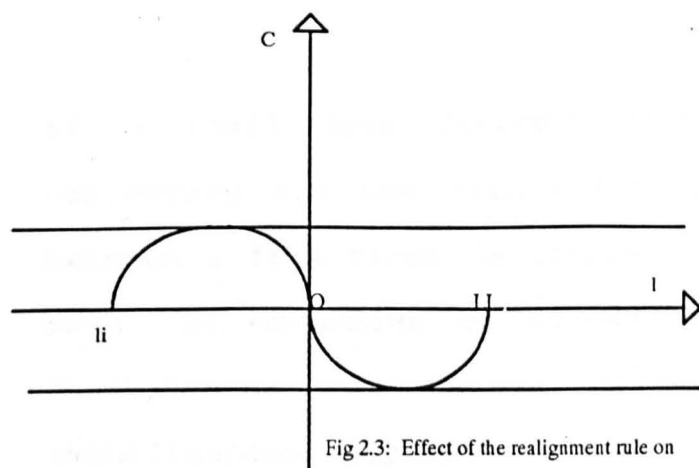


Fig 2.3: Effect of the realignment rule on

the real exchange rate

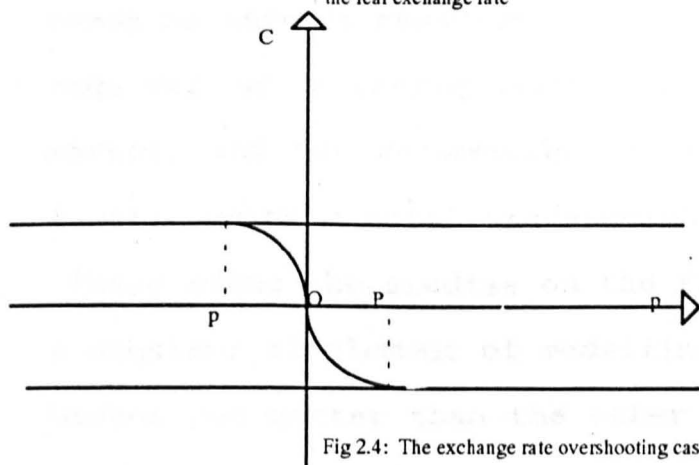


Fig 2.4: The exchange rate overshooting case

of a small open economy. The fluctuations between third currencies are the main external shocks. The choice will be between a free float, a single currency peg or a composite peg with the objective of stabilizing the economy in face the disturbances. But views differ on some aspects of the stabilization: emphasis on stabilizing domestic price, incomes, trade balance or resource allocation. In general, the free float requires as a prerequisite the development of the financial market, and the recommendation goes for a basket peg (managed float), using a total trade-weighting.

Three among the studies on the FZ are also reviewed. They have a substantial element of modelling. Nascimento (1987) finds the basket peg better than the other regimes including the present exchange rate regime while de Macedo (1987) suggests that the transfer from the large country to the small country might make a difference in favour of continuing the FZ exchange rate system. Devarajan & Rodrik (1991) compare the fixed rate regime to the float and conclude that the African countries of the FZ would be better off if they adopted a more flexible exchange rate.

There are some features in these models which might call for improvement, for example about the nature of disturbances considered or some particular assumptions. In the next chapters we intend to further carry on the modelling effort about the FZ case, taking into account a more extended range of shocks and also a larger choice between different exchange rate regimes, for a typical commodity-exporting economy. One of these exchange rate regimes is the currency band or target zone, sometimes presented as an intermediate case between a flexible rate and a fixed rate

system.

The target zone literature is more recent and its development might be related to the experience of ERM in Europe as well as the modelling of the regime shifts such as the return of Britain to the Gold Standard (Miller & Krugman 1992). It is based on the monetary model including the feature of rational expectations, combined with the assumption of flexible price or alternatively of sticky price. An explicit solution of the exchange rate inside the band as a function of the fundamentals is feasible in the flexible price specification while only qualitative features are available for the sticky price specification. The latter deals with the effect of the realignment rule on the real exchange rate and the case of overshooting for the nominal exchange rate.

Chapter 3. Comparing different exchange rate regimes: a simplified model

Introduction

For a given economy, the monetary authorities have usually to choose a fixed rate or a float regime upon which to conduct their exchange rate policy. This may appear as a very limited choice. But the fixed rate as well as the float regime can receive a very broad definition and each of them contains in fact a number of sub-categories which give the monetary authorities a more extended range of possibilities.

The present chapter explores the different options available. More precisely, it aims at determining the best exchange rate regime for a small commodity-exporting economy. In the context of a simplified model, price stability will be the criterion for the decision- making.

An important feature of the model will concern its stochastic setting on the one hand and the introduction of a Poisson process to represent the commodity price fluctuations on the other hand.

Section 3.1 presents the standard monetary model together with the specification of the Poisson process. Section 3.2 examines the choice for a criterion and discusses different possibilities at the hands of the monetary authorities, regarding the exchange rate policy to adopt. The next sections (3.3, 3.4 and 3.5) will respectively deal with:

- the managed float and its policy implications
- the target zone in the presence of anticipations.
- the basket peg in a three-country model and the extension to

a four-country representation to take into account the fluctuations between the key currencies.

3.1 The case of the standard model

In the following, the standard monetary model is used, including the PPP rule. For clarity of exposition, we will first consider the case where the shocks follow a Brownian motion process. Later on, the Poisson process will be introduced.

a. The model

The model considered below consists of the following equations (all variables are in logarithm except for the interest rate):

$$m-p=\gamma y_0-\lambda i \quad (1)$$

$$p=S+p^* \quad (2)$$

$$E(ds)=i-i^* \quad (3)$$

where : S = nominal exchange rate (foreign currency price in terms of the domestic currency)

m = money stock

p and p^* : domestic and foreign price levels

i and i^* : domestic and foreign interest rates

y_0 = full-employment output

the parameters have a positive sign: $\lambda > 0$ $\gamma > 0$

This set of equations give a very simplified representation of the economy. Equation (1) represents the money market equilibrium where λ is the semi-elasticity of money demand with respect to the interest rate and γ is the income elasticity. Equation (2) is the Purchasing Power Parity (PPP) relationship. It indicates that the same type of goods exists in the domestic economy and

abroad, and that the same price tends to prevail on either side of the border when expressed in the domestic currency or the foreign currency using the exchange rate. This means that the transport costs and other obstacles to international trade are negligible.

Equation (3) denotes the arbitrage condition on the financial market. The model assumes the existence of only two categories of assets: money as the non-interest bearing asset on the one hand and the bonds on the other hand. The domestic and foreign assets are considered as close substitutes. This justifies the uncovered parity specification in equation (3) whereby the domestic (nominal) interest rate equals the world interest rate augmented by the expected depreciation of the domestic currency.

In sum, this is the typical case of a small open economy with permanent equilibrium on the goods market. Also, perfect capital mobility will prevail. Another important feature of the model concerns the rational expectations hypothesis to describe the behaviour of the economic agents.

The latter point can be best emphasized by obtaining a reduced form from equations (1) to (3). To do so, the exogenous variables y_0 and i^* are normalized to zero in order to simplify the calculations. Note that implicitly other exogenous variables such as the foreign money supply and output are also normalized to zero. Equations (1) and (2) lead to:

$$m-S-p^*=-\lambda i \quad (4)$$

Replacing the nominal interest rate i in equation (4) by $E(ds/dt)$ from equation (3) gives the following expression:

$$m-S-p^*=-\lambda E(ds/dt) \quad (5)$$

According to equation (5), the nominal exchange rate appears as the present discounted value of the future "fundamentals" or key macroeconomic variables (cf chapter 2). It is a forward-looking variable or "jump" variable in the sense that its current value depends on present values as well as expectations about the future state of the fundamentals. In the present context, the fundamentals are represented by the money stock and the foreign price level. By assumption the shocks facing the domestic economy will come from these two variables. In general terms, the set-up identifies the exchange rate, the nominal interest rate and the domestic price level as the endogenous variables. The other variables in particular the money stock are exogenous.

As a result of the rational expectations assumption, equation (3) determines the interest rate i . Equation (1) gives the price level. If starting from equilibrium on the money market, an increase in y_0 or a decrease in i occurs for example, the demand for money will rise as a result. To restore equilibrium, the real balances need to increase sufficiently, which implies a decrease in p . On the other hand, if the initial equilibrium is disturbed by an increase in the money stock, then there would be an excess of money supply resulting in an excess demand for goods and a rise in p . This would reduce the real balances back to their initial level.

Equation (2) determines the exchange rate. The implicit assumption underlying this equation is that any change in p^* or p will be matched by an equivalent change in S to keep the parity between the goods prices on the home market and the foreign market.

On this issue of how the exchange rate is influenced, there exist two points of view. The first one corresponds to the above specification in which the sequence lets the money supply determine the price level which in turn gives the exchange rate. An alternative approach as advanced by Dornbusch (1976) would view the link between m and p as a long run process. In the short run, his argument goes, the money supply influences more directly the exchange rate which will in turn affect the price level. A case related to this second approach will be analyzed later on.

b. The solutions

Additional assumptions will be necessary in order to indicate how the stochastic process will drive the system. The solutions of the model will depend on the characteristics of these shocks.

The discussion of exchange regimes very often focuses on the case of a flexible exchange rate with a fixed money supply or alternatively the case of a fixed exchange rate with an endogenous money supply. The above framework directly fits the case of the flexible exchange rate.

To proceed with the analysis of this case, let us retain the usual description which specifies m and p^* as following a random walk. This is equivalent to describing them as Brownian motion processes in a continuous time setting as the one considered here. Under this assumption, the solution can be derived using equation (5) for example. If the exchange rate S is viewed as the present discounted value of the future fundamentals and if these fundamentals behave as random walks, then the expected change of S is zero. Indeed at any period t the exchange rate just as the

fundamentals is equally likely to increase or to decrease, and in consequence it stays constant on average.

Setting the terms on the right hand side of equation (5) equal to zero brings about the solution:

$$S = m - p^* \quad (6)$$

It follows that:

$$p = S + p^* = m \quad (7)$$

We have also the necessary equality between the domestic and foreign interest rate in the context where the prospects give no trend in the exchange rate.

The interpretation of equations (6) and (7) is quite straightforward. They describe the steady state solutions for the exchange rate and the domestic price level. In the long run, the exchange rate verifies a positive one-to-one relationship with the money supply and negative one-to-one relationship with the foreign price level. With regards the long run domestic price, it simply varies as the money supply.

The results in equations (6) and (7) are illustrated in figure 3.1. They correspond to the 45° degree line (by setting $p^*=0$ in equation 6).

What are the solutions in the case of a fixed exchange rate? To find the answer, one may set $S=0$ in the model since S is constant and then it follows that:

$$i = i^* \quad (8)$$

$$m = p = p^* \quad (9)$$

The adoption of a fixed exchange rate in the context of perfect capital mobility implies that the domestic price should be

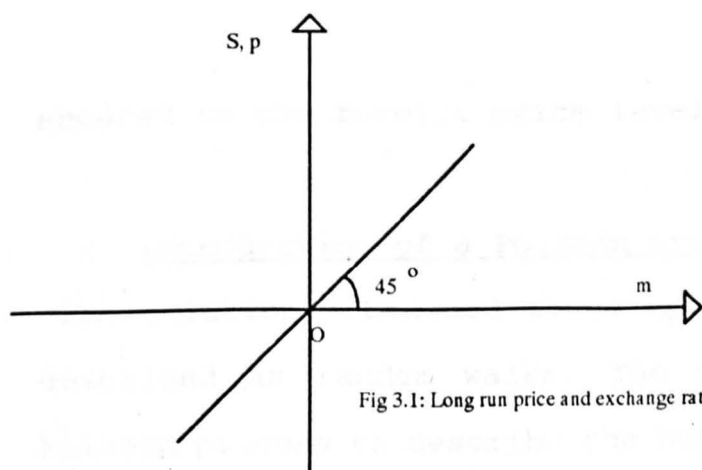


Fig 3.1: Long run price and exchange rate

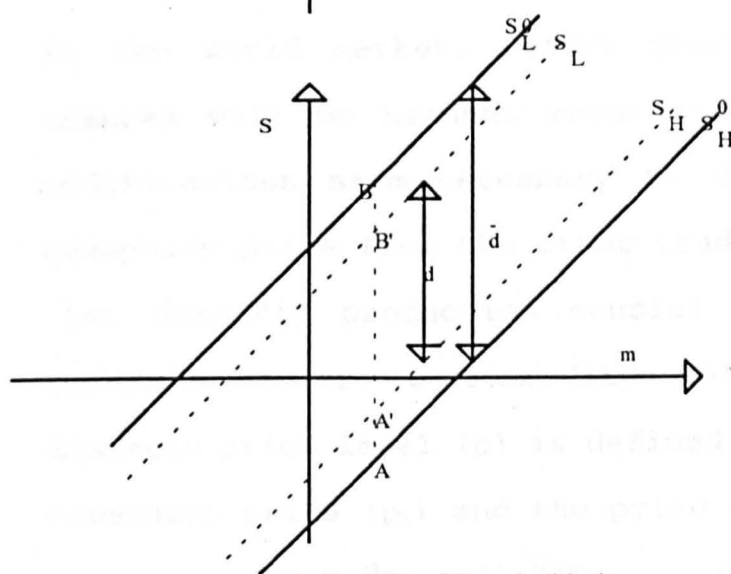


Fig 3.2: Effects of anticipation

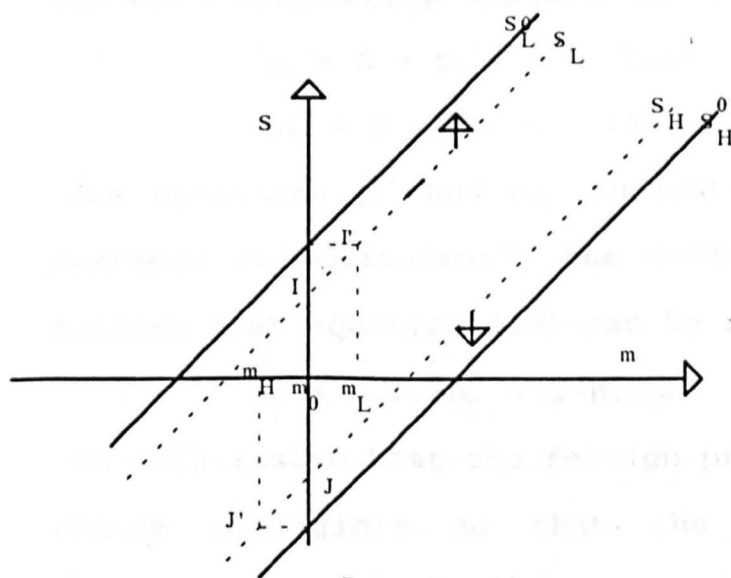


Fig 3.3: Managed float

equated to the foreign price level.

c. Introduction of a Poisson process.

The solutions obtained above apply when both m and p^* can be described as random walks. The present section introduces a Poisson process to describe the behaviour of the commodity price in the world market. Before proceeding further, some minor changes will be brought about to the above framework. These modifications seem necessary to distinguish the case of the commodity price from the other tradable goods price.

Let domestic production consist of two goods, both in the tradable sector: a commodity and another traded good. The domestic price level (p) is defined as a weighted average of the commodity price (p_c) and the price of the other tradable (p_{OT}):

$$p = \beta p_c + (1-\beta)p_{OT} \quad (10)$$

where β denotes the share of the commodity sector in the domestic economy and $1-\beta$ the share of the other tradable sector. The PPP relationship applies for each of these tradable goods:

$$p_c = S + p_c^* \quad (11)$$

$$p_{OT} = S + p_{OT}^* \quad (12)$$

The notations p_c^* and p_{OT}^* indicate the prices in the foreign currency or equivalently the world prices of these goods. It follows that equation (10) can be rewritten in the form:

$$p = S + \beta p_c^* + (1-\beta)p_{OT}^* \quad (13)$$

We will assume that the foreign production of the commodity is almost negligible so that the changes in the price p_c^* essentially affects the domestic economy.

As a matter of fact the world prices of a range of primary

commodities have fluctuated a great deal for the three last decades, but most notably since 1973 which witnessed the first oil price crisis. Graphics in chapter 1 provide a few illustrations for the commodities such as cocoa, coffee, and groundnut.

Sometimes the changes occurred between a maximum and a minimum in the proportion of five or more to one. For example the price of cocoa was 25 US cents per pound in the first quarter of 1972. In the third quarter of 1977 it reached its maximum of 184 US cents per pound. The price of coffee presents a similar pattern : a minimum of 45.5 US cents per pound in the first quarter of 1972 and a maximum of 288 US cents per pound in the second quarter of 1977. From this general picture, one might derive the idea to approximate the movements in the commodity price in the way as described below. Let us first consider a representative low level and a representative high level around the average price level during the period under review. Then, the commodity price is viewed as taking alternatively on these low and high levels only. To describe the fluctuations in the commodity price as a Poisson process amounts to an attempt at mirroring the succession of booms and busts on the commodity markets for at least two decades now. Such a representation differs somewhat from the more common treatment of the commodity price like the other assets as space-continuous stochastic processes. As argued by Merton (1971), there may be some reason to prefer a Poisson process representation which allows discrete, instead of continuous, variations in the state variable. The fact that the commodity price typically jumps to its low or high level and

stays there for a while justifies the recourse to the Poisson process specification.

The Poisson process of p^* is described as follows: there are formally two states of the nature: Low and High. The low and high values of p_c^* are denoted p_L^* and p_H^* respectively. The transition probabilities from one state to another are summarised in this box:

Transition probabilities
of the Poisson process

	L	H	Σ
L	π_{LL}	π_{LH}	1
H	π_{HL}	π_{HH}	1

For example, π_{LL} and π_{HH} are the probabilities of the commodity price p^* not changing the next period when it is already at its low level p_L^* and high level p_H^* , respectively. The change from p_L^* to p_H^* occurs with probability π_{LH} , and from p_H^* to p_L^* with probability π_{HL} . Newberry (1990) notes the profile that generally characterises the time series of commodity prices with rather long flat troughs compared with sharp peaks. In the context of the present model, this implies that the probability distribution of the commodity should satisfy the following conditions:

$$\pi_{LL} > \pi_{HH} \quad \pi_{LH} < \pi_{HL}$$

The notation for the exchange rate will be similar: S_L and S_H are used to denote the low level (maximum depreciation) and high

level (maximum appreciation) corresponding to p_L^* and p_H^* respectively.

d. Solution with a Poisson process

i) m : fixed and p_c^* :Poisson process

Let us first assume that m is not subject to shocks ($m=m_0$) in order to concentrate on the analysis of the Poisson process in p_c^* . For example one may, from equation (13), denote by p^* the weighted average of the commodity price in the world market p_c^* and the foreign price of other goods p_{ot}^* . Both p_c^* and p_{ot}^* are valued in foreign currency. Let us assume that p^* represents the foreign price using local weights. It gives the price index of the small economy when the exchange rate is fixed and equal to zero. Thus

$$p^* = \beta \cdot p_c^* + (1-\beta)p_{ot}^* \quad (14)$$

where β represents the commodity share in domestic production.

We assume that the relative changes in p^* originate from the disturbances on p_c^* so that p^* will behave in the same way as p_c^* .

One may even simplify the notations by setting p_{ot}^* equal to zero, which gives:

$$p^* = \beta \cdot p_c^* \quad (15)$$

which implies, taking account of (13), that: $p = S + \beta p_c^*$

Before we derive the solution, one may recall that in the usual case where p_c^* is considered as fixed while m follows a Brownian motion process or where both m and p^* are supposed to be Brownian motion processes, the free float solution has the form (cf equation 6):

$$S = m - \beta p_c^* \quad (16)$$

Equation (16) is obtained by setting $E(ds/dt) = 0$ in equation (5) under the free float regime.

Now we assume that p_c^* evolves as a Poisson process and, since the transition probabilities are known, the expected variation of the exchange rate in response to the commodity price shock can be obtained, depending on the starting point of the system. For this purpose, equation (5) may be rewritten in the form:

$$E(dS/dt) = \lambda^{-1}(S - m_0 + \beta p_c^*) \quad (17)$$

If the system starts from a low level, that is at $p_c^* = p_L^*$, then equation (17) takes the form:

$$\pi_{LH}(S_H - S_L) = \lambda^{-1}(-m_0 + S_L + \beta p_L^*) \quad (18)$$

Similarly, in the case the system was initially in the position $p_c^* = p_H^*$ we would have:

$$\pi_{HL}(S_L - S_H) = \lambda^{-1}(-m_0 + S_H + \beta p_H^*) \quad (19)$$

What is contained in both equations (18) and (19) gives an illustration of the way the participants in the financial market conduct their expectations about the future value of the nominal exchange rate. The left hand side indicates that the exchange rate may stay at the same level S_L^* if the commodity price does not jump with probability π_{LL} (or π_{HH} if the starting point was S_H^* instead of S_L^*), implying that the variation is nil or alternatively it may move to the other position with probability π_{LH} (or π_{HL}). On average the expected change amounts to:

$$\pi_{LH}(S_H - S_L) \quad [\text{or} \quad \pi_{HL}(S_L - S_H)]$$

These expectations are assumed to be rational in the sense that they convey all the information available at the current period,

that is by the time the expectations are formed.

Solving the system (18) and (19) brings the solutions S_L and S_H as follows:

$$S_L = m_0 - \beta \left[\frac{1 + \lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} \cdot p_L^* + \frac{\lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} \cdot p_H^* \right] \quad (20)$$

$$S_H = m_0 - \beta \left[\frac{\lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} \cdot p_L^* + \frac{1 + \lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} \cdot p_H^* \right] \quad (21)$$

The rate S_L or S_H appears as the sum of two terms: m_0 and a second term which is a linear combination of βp_L^* and βp_H^* . The weights involve the transition probabilities and the semi-elasticity of the demand for money with respect to the interest rate.

The results of equations (20) and (21) can be generalized to the case where m follows a Brownian motion process instead of being constant.

ii) m : Brownian motion process and p_c^* : Poisson process.

In the above analysis, we assumed that the velocity-adjusted money was not subject to shocks. This assumption is now lifted and m will follow a Brownian motion process:

$$dm = \sigma dz \quad (22)$$

equation in which z is a Wiener process and σ^2 denotes the variance of the Brownian process.

The characterisation of the money shocks as a Brownian motion process represents simply a restatement of the common practice of considering the money variable as a random walk variable. An alternative assumption may view m as a stationary variable but

plenty of empirical evidence has rejected such a description in favour of a series integrated of degree one usually denoted $I(1)^{10}$. This means that the increments of the money supply are stationary.

We may rewrite equation (5) as follows:

$$s-k=\lambda E(ds/dt) \quad (23)$$

where the variable k represents the fundamentals and equals $m-\beta p_c^*$. It contains two stochastic elements. The variable m follows a Brownian motion process as defined above. With regards p_c^* , it follows a Poisson process as before, so that the total differential of k takes the form:

$$dk = \sigma dz - \beta dp_c^* \quad (24)$$

In the sense of equation (24), the fundamentals k have the form of the so-called jump diffusion process because it combines a random walk and a jump process. This shows that the specification of the commodity price behaviour itself might be extended to a jump diffusion process without any additional difficulty.

The standard model of the above subsection will be retained so that to analyze the specific implications of combining equations (23) and (24).

Regarding S as a function of k , we intend to calculate its differential. For this purpose, let us assume that the system rests in the position $p_c^*=p_L^*$.

Alternatively this initial position might be p_H^* . By means of a generalized form of Ito's lemma, the differential of S may be written as follows:

¹⁰That the money stock can be described as an $I(1)$ variable was given a supplementary evidence using the data of South Korea in my MSC dissertation (1992).

$$dS = \sigma \cdot S'(k) dz + \sigma^2/2 \cdot S''(k) dt + [S(k - \beta(p_H^* - p_L^*)) - S(k)] d\theta^* \quad (25)$$

where θ^* denotes the variable describing the Poisson probability distribution, and the changes $(p_H^* - p_L^*)$ in the state variable (i.e. world price of the commodity) denote the size of the commodity price jump from the level p_L^* ¹¹.

Taking the expected value of equation (25) gives:

$$E(dS) = \sigma^2/2 \cdot S'' dt + \pi_{LH} [S(k - \beta(p_H^* - p_L^*)) - S(k)] dt \quad (26)$$

The parameter π_{LH} corresponds to the mean of the Poisson process and gives the density of the "event": jump of the state variable which is here the commodity price p_c^* , when the system is already at the position corresponding to $p_c^* = p_L^*$. It can be interpreted here as the "transition probability".

At this position, we have also $k = m - \beta p_L^*$

Substituting (26) and the value of k into (23) leads to:

$$S(m - \beta p_L^*) = m - \beta p_L^* + \lambda \cdot \sigma^2/2 \cdot S''(m - \beta p_L^*) + \lambda \cdot \pi_{LH} [S(m - \beta p_H^*) - S(m - \beta p_L^*)] \quad (27)$$

or equivalently:

$$(1 + \lambda \cdot \pi_{LH}) S(m - \beta p_L^*) = m - \beta p_L^* + \lambda \cdot \sigma^2/2 \cdot S''(m - \beta p_L^*) + \lambda \cdot \pi_{LH} \cdot S(m - \beta p_H^*) \quad (28)$$

¹¹ The probability distribution of p_c^* has been broken into two components: the first component relates to the size (random variable) of the jump and the second is related to the occurrence of the "event", that is, the change in the state variable. The latter is represented by θ^* and corresponds to the proper Poisson distribution. The former equals $p_H^* - p_L^*$ with probability one (cf R. Merton, 1971 and A. Dixit & R. Pindyck, 1994).

By symmetry, we can obtain the relationship in the case where the system rests in the position corresponding to $p_c^* = p_H^*$.

$$(1 + \lambda \cdot \pi_{HL}) S(m - \beta_{p_H}^*) = m - \beta_{p_H}^* + \lambda \cdot \sigma^2 / 2 \cdot S''(m - \beta_{p_H}^*) + \lambda \cdot \pi_{HL} S(m - \beta_{p_L}^*) \quad (29)$$

The results

For the solution of equation (28), we refer to the method used by Perraudin (1990) and will look for a solution of the form:

$$S_L \equiv S(m - \beta_{p_L}^*) = A_0 \cdot m + A_1 + B_1 \exp(\gamma_1 m) + B_2 \exp(\gamma_2 m) \quad (30)$$

More specifically, in the case of the free float being considered here there is need to set $B_1 = B_2 = 0$ to avoid explosive situations.

Similarly, the solution corresponding to $p_c^* = p_H^*$ will be set as:

$$S_H \equiv S(m - \beta_{p_H}^*) = A_0 \cdot m + A_2 \quad (31)$$

Substituting (30) and (31) into (27) gives:

$$(1 + \lambda \cdot \pi_{LH}) (A_0 m + A_1) = m - \beta_{p_L}^* + \lambda \cdot \pi_{LH} (A_0 m + A_2) \quad (32)$$

or equivalently:

$$A_0 m + (1 + \lambda \cdot \pi_{LH}) A_1 = m - \beta_{p_L}^* + \lambda \cdot A_2 \quad (33)$$

This implies:

$$A_0 = 1$$

$$\text{and } (1 + \lambda \cdot \pi_{LH}) A_1 = -\beta_{p_L}^* + \lambda \cdot \pi_{LH} \cdot A_2$$

Similarly, we obtain:

$$\Rightarrow A_1 = \frac{\beta p_L^*}{1 + \lambda \cdot \pi_{LH}} + \lambda \cdot \frac{\pi_{LH}}{1 + \lambda \cdot \pi_{LH}} A_2 \quad (34)$$

$$A_2 = \frac{\beta p_H^*}{1 + \lambda \cdot \pi_{HL}} + \lambda \cdot \frac{\pi_{HL}}{1 + \lambda \cdot \pi_{HL}} A_1 \quad (35)$$

Combining equations (34) and (35) enables us to solve for A_1 and A_2 :

$$A_1 = -\beta \left[\frac{1 + \lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{\lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] \quad (36)$$

$$A_2 = -\beta \left[\frac{\lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{1 + \lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] \quad (37)$$

Therefore the solutions are as follows:

$$S_L = m - \beta \left[\frac{1 + \lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{\lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] \quad (38)$$

$$S_H = m - \beta \left[\frac{\lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{1 + \lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] \quad (39)$$

The results in equations (38) and (39) are essentially the same as in the previous case which gave equations (20) and (21). The free float framework means that the terms in exponential which may appear in the Brownian+Poisson process¹² model are

¹²This notation means that the shock in m is a Brownian process while the shock in p_c^* is a Poisson process.

eventually put to zero to get a linear form. An illustration is given in diagram 3.2. The representation is the (m, S) space. The 4 straight lines S_L^0 and S_H^0 correspond to the solutions when no anticipations of reversals in the commodity price are present, starting from positions Low and High respectively. The straight lines S_L and S_H are introduced to represent the solutions taking account of the anticipations. In both cases, a lower level of p_c^* means a depreciation of the exchange rate: $S_L^0 > S_H^0$ and $S_L > S_H$.

The comparison of equations (38) and (39) with the solution corresponding to a deterministic p_c^* or Brownian+Brownian case¹³, in equation (16), denoted by $S_L^0 = m - \beta p_L^*$ and $S_H^0 = m - \beta p_H^*$, indicates that introducing the Poisson process results in dampening the impact of the commodity price shock on the exchange rate. The change in the exchange rate has the same direction as before with a rise in the commodity price causing an appreciation of the exchange rate and vice versa but, one has the relative positions $S_L < S_L^0$ and $S_H < S_H^0$ as illustrated in figure 3.2. The exchange rate switches between points A' and B' instead of A and B.

The distances d and \bar{d} provide a measure of the effect of anticipations about the changes in the commodity price and

$\bar{d} = S_L^0 - S_H^0 = \beta(p_H^* - p_L^*)$ is greater than $d = S_L - S_H$. The compared distances provide an indicator of the smoothing undergone by the exchange rate due to these expectations. The calculations give:

$$d = S_L - S_H = \frac{\lambda^{-1}}{\lambda^{-1} + \pi_{LH} + \pi_{HL}} \beta(p_H^* - p_L^*) \quad (40)$$

¹³ The Brownian+Brownian case is when both m and p_c^* follow Brownian motion processes.

or equivalently:

$$d = \frac{1}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} \beta (p_H^* - p_L^*) \leq \beta (p_H^* - p_L^*) = \bar{d} \quad (41)$$

The difference between d and \bar{d} can be viewed as the direct effect of the agents anticipating the future level of the commodity price on the world market on the basis of their knowledge that the latter behaves like a Poisson process. It is interpreted as reflecting the smoothing effect of expectations on the exchange rate. A low value of d corresponds to a large smoothing effect. When the commodity price is at level p_L^* for example, the market believes there is some chance that it will increase in the next period. Consequently, the exchange rate appreciates on average. It does so in particular because a higher world price of the exports will bring more foreign exchange which should be rendered to the Central Bank for the domestic currency in return. An excess demand for the domestic currency will result. Then the exchange rate needs to appreciate for the money market to get back to equilibrium. The prospect of a rise in the value of the domestic currency adds to its attractiveness now and its appreciation as a consequence. Indeed the rational behaviour of the economic agents rules out that infinite plus-values be ripped at the moment the rise in the commodity price occurs. This account goes some way in accordance with the remark by Frankel (1983) about the predominance of unanticipated movements in fundamentals to explain the short term movements in the exchange

rate: a very strong anticipative behaviour of the agents would mean a reduction in the distance d (as illustrated by the difference between d and \bar{d}).

Conversely, expectations will lead to a depreciation on average when the commodity price is at its high level p_H^* .

We note from equation (41) that the smoothing effect decreases when either of the parameters π_{LH} and π_{HL} , or λ decreases. In particular, when π_{LH} and π_{HL} are very small, that is when the jumps occur very rarely then the external disturbance implied by these jumps comes almost as a surprise, and there will little smoothing effect as the agents were not well prepared to these events. The distance d will tend to reach its maximum \bar{d} .

As regards the parameter λ , we note the similarity with π_{LH} and π_{HL} since it multiplies them in equations (40) or (41). This parameter reflects the extent to which a change in the expectations for the nominal exchange rate, whatever the source of these variations will affect the real balances via the interest rate and consequently the domestic price and the actual exchange rate.

The point to underline here is essentially that the solution obtained by the introduction of the Poisson process puts more emphasis on the role of expectations for the determination of the exchange rate. Furthermore this solution appears as a weighted average of the solutions in the Brownian process model corresponding to the low and high levels of the commodity price respectively. More specifically:

$$S_L = \omega_L (m - \beta p_L^*) + (1 - \omega_L) (m - \beta p_H^*) \quad (42)$$

$$S_H = (1-\omega_H)(m-\beta p_L^*) + \omega_H(m-\beta p_H^*) \quad (43)$$

where

$$\omega_L = \frac{1+\lambda \cdot \pi_{HL}}{1+\lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} \quad (44)$$

$$\omega_H = \frac{1+\lambda \cdot \pi_{LH}}{1+\lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} \quad (45)$$

Further discussion on the implications is contained in section 3.4

3:2 Choice for a criterion

The comparison between different exchange rate regimes will involve the use of a criterion. Different possibilities exist. The authorities of the domestic economy may choose to stabilize some macroeconomic variable such as output, the price level or the exchange rate. Because of their risk adverse attitude, consumers and producers encounter a loss in their utility and efficiency when faced with uncertainty. There is a number of variables which potentially matter in this respect, in the sense that their instability actually affects negatively the welfare of the representative consumer.

a. The different possibilities

Very often, the construction of a welfare function bears on the concept of output and/or price stability. Before a further discussion on this general practice, let us review other possibilities in which exchange rate stability or balance of

payments are used as a benchmark for the decision-making.

To start with, one may argue that the exchange rate constitutes an important variable and its variations may disturb significantly the equilibrium of the economy. For example, the profitability, of investment in traded good sectors could be adversely affected by the uncertainty due to the changes in the exchange rate. The counter-argument though would compare the size of the assets and liabilities in domestic currency and in foreign currency respectively. In practice, the former is much more important than the latter, Korteweg (1982). On this basis, the domestic price stability contributes more to the global stability of the economy than the exchange rate stability would do.

The real exchange rate represents a measure of relative prices, typically the relative price of the tradable goods (with respect to the non-traded goods). Its changes imply a modification in the allocation of resources between sectors. This is also about changes in the degree of competitiveness. The adjustment costs involved by variations in the real exchange rate may be high, depending on the degree of the flexibility which characterises the economy. The argument for targeting the real exchange rate most powerfully applies when this means offsetting an inflation differential with respect to the foreign trade partners. But it may not apply under some particular conditions, for example when real shocks are the underlying cause of the divergence. In this case, it is generally agreed that an accommodating policy seems better. The main reason emphasized by the literature comes from the fact that the determinants of the real exchange rate prove to be rather difficult to trace.

Therefore, there exist some uncertainty and risk in fixing and pursuing a target for the real exchange rate.

The balance of payments or more precisely the current account of the balance of payments represents another variable of interest. The monetary authorities may not perceive it as an aim in itself but more as a constraint. An open economy needs to run a sustainable current account balance. By this, it is generally meant that the deficit of the balance of payments should not go beyond the level which can be financed by "autonomous" borrowing, that is, the normal functioning of the capital account without notably heavy involvement of the Government. Generally a deficit which is larger than that level would bring about an active role of the Government to borrow to finance the gap. There is a cost attached to such a high deficit and borrowing in the form of a higher and increasing interest rate, reflecting very often a loss of creditworthiness of the economy. Some benefit may accrue from running a trade deficit since it allows to reach a higher level of consumption than would otherwise be. In a sense, the adjustment may be delayed or smoothed but this presents a favourable policy profile only to the extent that the underlying cause of the deficit is temporary. If on the contrary the cause has a structural nature, the extra cost very quickly will outweigh the benefit. The balance of payments is probably best viewed as a constraint than an objective function although one should not deny that it has welfare implications.

The different variables, reviewed so far: the exchange rate (real or nominal) and the balance of payments constitute as a matter of fact intermediate targets for the ultimate targets

which are the real income/consumption and price stability. From a historical perspective, the demand-oriented models tended to retain the output stability as the main argument in the welfare function. These models assumed the price level to be relatively fixed. The analysis then evolved to incorporate both the price and output stability to reflect the sort of simultaneity in the determination of these two aggregates. Furthermore, the models which assume price flexibility to some extent tend to consider the output determined and fixed at its full employment level so that the welfare function consists mainly of the price stability argument.

The simplified type of model as the one considered here which takes output as fixed, leads to place the emphasis on price stability as the main criterion. Inflation matters maybe more by experience because its devastating effects are largely known than theoretically established. A durable and sustainable economic growth requires a sine-qua-non condition which is price stability. Most of adjustment programs include fighting inflation among their most important policy actions. Lal (1991) gives an account of "growth collapses" for a sample of developing countries. The rate of inflation seems to have been one of the most important factors. For the demonstration, the sample had been divided into two groups of countries following the categorisation proposed by Harberger (1987) between countries with acute inflation and the others. The failures in terms of growth occurred most in the acute-inflation group.

Whatever the initial cause, fiscal deficit for example, price instability has adverse distributional effects. Most importantly

it provokes inflationary expectations which result in an accelerating trend. This causes uncertainty which works against a sustainable growth: more inflation would result in increased uncertainty and consequently in more hindrance in the decision-making of the agents.

In the domain of inflation as in others, it is also a matter of degree. "Moderate, anticipated inflation" is believed to do no harm. Instead it may be more compatible with a given target of output growth and employment level. The problem arises when it reaches a critical level at which it is difficult for the monetary authorities to convince the public and to reverse the expectations of accelerating inflation.

In most circumstances, an economy plagued with an acute inflation has no alternative but to adjust, and this is a painful process and it proves very often to involve high costs both in social and political terms.

This provides the background behind the choice made here to use price stability in the comparison between different exchange rate regimes.

b. Price variability

We are going to use the variance to measure price instability. In more precise terms, the variance of the price level equals by definition the expected squared variations around the expected mean value. This confers the property of optimality to the expected mean value which corresponds to the notion of target: the expected mean value will equal the target when such a target exists.

i) Solution for the price

The calculations above have given the solutions for the exchange rate. Similarly, we can derive the solutions for the domestic price.

Combining the solutions for the nominal exchange rate and the PPP relationship will provide the solution for the domestic price at positions L and H respectively.

$$p_L = S_L + \beta p_L^* = m - \frac{\lambda \pi_{LH}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \beta (p_H^* - p_L^*) \quad (46)$$

$$p_H = S_H + \beta p_H^* = m + \frac{\lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \beta (p_H^* - p_L^*) \quad (47)$$

It appears that an increase in the commodity price undoubtedly results in an increase in the domestic price.

$$p_H - p_L = \frac{\lambda \pi_{LH} + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \beta (p_H^* - p_L^*) > 0 \quad (48)$$

But in contrast to the case of the exchange rate, the difference between the high and low levels of the domestic price increases with the parameters λ , π_{LH} or π_{HL} . The reason is simply because when the smoothing of the exchange rate is lower as a result of smaller values of these parameters, the shocks will be better absorbed by the exchange rate, and the domestic price level will experience less variation, everything else being equal. But the indication of the domestic price variability is best given by its variance.

ii) Variance

A differential equation similar to (26) may be used for the domestic price as a function of m and p_c^* . This will enable us to look at the issue of the price variance. For a linear form of p , this would give, around position L:

$$dp = (\partial p / \partial m) \sigma dz + \pi_{LH} (p_H - p_L) d\theta^* \Rightarrow E dp = \pi_{LH} (p_H - p_L) dt \quad (48)$$

Considering that the terms in dt^2 are negligible, we have the variance of p , V_p :

$$\begin{aligned} V_p &\equiv E(dp)^2|_L - (E(dp)|_L)^2 \approx E(dp)^2|_L \text{ and thus} \\ V_p &= (\partial p / \partial m)^2|_L \sigma^2 dt + \pi_{LH}^2 (p_H - p_L)^2 dt \\ &\quad + 2(\partial p / \partial m)^2 \sigma \pi_{LH} (p_H - p_L) \rho_{LH} dt \quad (49) \end{aligned}$$

The expression of the solution for the domestic price indicates that at equilibrium we have: $\partial p / \partial m = 1$, which implies:

$$\Rightarrow E(dp)^2/dt|_L = \sigma^2 + \pi_{LH}^2 (p_H - p_L)^2 + 2\sigma \pi_{LH} (p_H - p_L) \rho_{LH} \quad (50)$$

Similarly, around position H:

$$E(dp)^2/dt|_H = \sigma^2 + \pi_{HL}^2 (p_H - p_L)^2 - 2\sigma \pi_{HL} (p_H - p_L) \rho_{HL} \quad (51)$$

where ρ_{LH} and ρ_{HL} represent the coefficients of correlation between m and p_c^* , when the system is at levels corresponding to p_L^* and p_H^* respectively. They are assumed to verify:

$$-\rho_{HL} = \rho_{LH} = \rho \quad (52)$$

where ρ will be used to denote the coefficient of correlation. This simply means that the effect of an increase in the commodity price on the money stock is the opposite of the effect resulting from a decrease. The question whether ρ equals zero or not will not be addressed directly here. But one can argue that in the long run, ρ will tend to take on zero values when the current account of the balance of payments returns to equilibrium. However, in the short run, we should expect positive values since an increase in p_c^* will result in a trade surplus and cause the money supply to increase.

According to some studies (e.g. Edwards 1986), m and p_c^* may be considered to have a positive correlation.

A more detailed form of (50) and (51) will be obtained if the explicit expression of $p_H - p_L$ is derived from (46) and (47) as follows:

$$p_H - p_L = \frac{\lambda\pi_{LH} + \lambda\pi_{HL}}{1 + \lambda\pi_{LH} + \lambda\pi_{HL}} \beta (p_H^* - p_L^*) \quad (53)$$

The variances of the domestic price at positions L and H take the form:

$$Vp_L = \sigma^2 + \pi_{LH} \left(\frac{\lambda\pi_{LH}}{1 + \lambda\pi_{LH} + \lambda\pi_{HL}} \right)^2 \beta^2 (p_H^* - p_L^*)^2 + 2\sigma\rho\pi_{LH} \frac{\lambda\pi_{LH} + \lambda\pi_{HL}}{1 + \lambda\pi_{LH} + \lambda\pi_{HL}} \beta (p_H^* - p_L^*) \quad (54)$$

$$Vp_H = \sigma^2 + \pi_{HL} \left(\frac{\lambda \alpha_{HL} \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \right)^2 \beta^2 (p_H^* - p_L^*)^2 + 2\sigma\rho\pi_{HL} \frac{\lambda \pi_{LH} + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \beta (p_H^* - p_L^*) \quad (55)$$

As one would expect the variance of the domestic price level will be greater, the larger is the variance of the money shocks and/or the size of the jump in the commodity price.

As one might expect the variance of the domestic price increases one for one with the variance of velocity shocks and positively with the size of the jumps in commodity prices, with a weight shown by the second term in the equations above. It is important to note that the variance also depends positively on the probabilities of transition π_{LH} and π_{HL} (and if these differ, then the ex-ante variance will be state contingent, i.e. depend on whether the price is high or low). In particular if high expectations about the change in the commodity price characterize the economic environment, then they will translate into a higher variance of the domestic price. This provides a further illustration in a particular context of the role of anticipations in price instability, as argued above. Looking at the recent events in the ERM and at exchange rate variability, Restoy (1994) notes that exchange rate risk under imperfect credibility may be divided into two components: the first one corresponds to the traditional indicator (within regime) while the second one is a correction term which depends on the probability of regime switch.

In addition, the expression of the variance indicates that the existence of a correlation between the two shocks will matter since a higher correlation would mean a higher price instability.

The effect of the two shocks reinforce each other. A rise in the commodity price (in foreign currency) causes an increase in the domestic price. In the presence of a positive correlation between the shocks, the rise in the commodity price will also cause the money stock to increase, which will add to the first increase in the domestic price.

The expression derived for the price variability concerns the case of a flexible exchange rate. The remainder of this chapter will proceed with the comparison between different exchange rate regimes on the basis of the variance that the domestic price takes on in each regime.

3.3 Flexible versus fixed exchange rate

The choice for an exchange rate is taken here to be motivated by price stabilization. Given that the small economy faces shocks which cause price variability, the aim that the monetary authorities seek to achieve will consist of minimizing the domestic price instability. As a consequence, the Government budget in particular is not included in the simplified framework presented above.

There exists an extensive literature on the issue as reviewed in chapter 2. The general conclusion which seems to emerge is that a flexible rate stabilizes the domestic price better than the fixed rate in the presence of external disturbances and conversely price stability is more easily achieved with a fixed rate regime in the presence of internal (monetary) disturbances. The case to be examined here relates to the simultaneous presence of these categories of shocks. Furthermore, the analysis is

extended to the case where for one of the disturbance, namely the commodity price, a Poisson process specification applies better than a random walk specification.

A priori a number of phenomena may shock a small open economy. They include unanticipated changes in the domestic supply or demand on the goods market, exogenous changes in inflation, shifts in demand for money, fluctuations in the world price or capital inflows or even between the major currencies.

As a matter of fact, the calculations undertaken for the flexible rate regime implicitly adopted the simplification that these different possibilities can be summarized by two categories of shocks: the money stock or velocity shock as the first category to represent the internal disturbances and the terms of trade shocks as the second category to represent the external disturbances. The same assumption will apply to carry out the calculations and to derive the solutions for the fixed exchange rate.

a. Solutions of the fixed exchange rate regime.

In the fixed rate regime, the nominal exchange rate is given at a level S_0 . The monetary model takes the following form:

$$m-p=\gamma y_0-\lambda i \quad (1')$$

$$p=S_0+p^* \quad (2')$$

$$i=i^* \quad (3')$$

As before, the nominal interest results from the third equation. In the context of a fixed exchange rate and perfect capital mobility, it simply equals the interest prevailing on the

international financial markets. Any divergence from i^* , for example a decrease in i would provoke a permanent outflow of capital unless the domestic interest rate is increased back to its initial level. A particular feature to emphasize in the fixed rate case is that the money stock becomes endogenous. Its determination is contained in equation (1') while now equation (2') determines the price level. The peg of the nominal exchange rate requires that domestic inflation be equalized to foreign inflation (equation 2'). Any departure from the linkage with the world economy in the form of a higher inflation as a result for example of larger domestic credit in face of a fixed demand for money will translate into a trade deficit. A depletion of the foreign assets (which are the other counterpart of the money stock beside the domestic credit) will follow until it completely offsets the initial increase operated via the credit channel. Following a monetary shock, the money stock is adjusted to offset the disturbance in order to keep the interest rate equal to the international level. Also this maintains the money market equilibrium and makes the price level insensitive to the monetary shocks.

Equation (3') represents the most common specification for a peg. But there may be the case where although the current exchange rate is fixed, its expected variation differs from zero. Prospects of realignments for a weak currency in a multiple-currency peg system or a non-credible peg of a overvalued currency to a key currency provide illustrations of such a possibility.

For the time being though, the simplified model specifies the

arbitrage condition as a pure equality between the domestic and foreign interest rates in the peg regime.

Another implicit simplification relates to the description of the manner in which the money stock behaves. The latter is supposed to verify:

$$dm = \sigma dz \quad (56)$$

This is not particular to the fixed exchange rate: it applies to the flexible rate regime as well.

A more general formula would include the core inflation term (π) , that is the rate of the expected money growth:

$$dm = \pi dt + \sigma dz \quad (56')$$

The inclusion of the core inflation might matter, particularly when the analysis involves a comparison between countries in which the expectations about future inflation differ significantly for a reason or another. Introducing the core inflation π would augment the domestic price variance in equations (50) and (51) by the additional term $\pi^2 dt$. This may explain why the FZ countries in matters of inflation generally have performed better than the neighbouring countries where the former group have relatively low inflationary expectations because of the peg to the large currency. But these aspects are not considered since the focus is on the effect of shocks and their implications for the exchange rate policy, everything else being equal.

Let us rewrite the solution for the price level with a normalization to zero of the fixed nominal exchange rate, as follows:

$$p = \beta p_c^*$$

The domestic price will then follow a Poisson process and verify the differential form below, where the notations are the same as in the previous sections:

$$dp_{|L} = \beta (p_H^* - p_L^*) d\theta_L^* \quad (57)$$

$$dp_{|H} = \beta (p_L^* - p_H^*) d\theta_H^* \quad (58)$$

It follows that the variance will equal:

$$Vp_{|L} = \beta^2 \pi_{LH} (p_H^* - p_L^*)^2 \quad (59)$$

$$Vp_{|H} = \beta^2 \pi_{HL} (p_H^* - p_L^*)^2 \quad (60)$$

As expected, in the fixed exchange rate regime the variance of the domestic price is identical to the variance of the foreign price level. It does not include the variance of the money shocks: this is due as already indicated, to the fact that the money supply has become endogenous.

The variance depends exclusively on the distance between the low and high levels of the commodity price and other characteristics of its probability distribution. In the context of rational expectations whereby the economic agents have a knowledge of the economic model, including the process according to which the foreign price behaves, these characteristics are among the factors which guide the expectations.

b. Comparison between the two regimes.

The question to answer now comes to the choice between two alternative exchange rate regimes. The authorities seek to

minimize the loss function defined as the price instability or variance. The exercise will amount to comparing the variance of the price level which may be obtained in the two regimes. To facilitate the comparison, we consider only the case where the system rests at position L. Also the correlation coefficient is assumed to equal zero. Then the flexible regime would be preferred to the fixed rate regime if the following inequality holds:

$$\sigma^2 + \pi_{LH} \left(\frac{\lambda \pi_{LH} + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \right)^2 \beta^2 (p_H^* - p_L^*)^2 < \pi_{LH} \beta^2 (p_H^* - p_L^*)^2 \quad (61)$$

This is equivalent to:

$$\frac{\sigma^2}{\pi_{LH} \beta^2 (p_H^* - p_L^*)^2} + \left(\frac{\lambda \pi_{LH} + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \right)^2 < 1 \quad (62)$$

The two terms on the left hand side of expression (62) can be characterized with reference to the standard analysis. The first term represents the ratio of the money shock variance with respect to the variance of the commodity price shocks. Very often the literature, when comparing the two alternative exchange rate regimes comes to the conclusion in favour of a flexible rate if the economy faces external shocks. Conversely in case of internal shocks, the recommendation points to the fixed exchange rate regime. More precisely though, as a generalization, the source as well the relative importance of the two types of shocks should

be considered. That is the sense of the ratio corresponding to the first term of (62).

The second term relates to the anticipations of reversals. Without these anticipations, that is in the case where any jump in the commodity price is permanent, we recall that the exchange rate would respond by completely offsetting any change in the foreign price level and therefore insulate the domestic price from these shocks. Under such conditions, the variability of the price would be equated to the variance of the monetary shocks. The presence of anticipations of reversal has the effect of lessening the change in the exchange rate which no longer responds on a one-for-one basis. The domestic price level shows some variability as a result. This is represented by the second term of (62). Everything else being equal, the role played by the anticipations tends to diminish the case for a free float. The second term represents this effect as a positive and increasing function of the interest rate semi-elasticity or the transition probabilities.

Lifting the assumption of a zero correlation between the two shocks would add a third term in the expression (62) of the form:

$$2\rho \frac{\sigma}{\pi_{LH} \beta (P_H^* - P_L^*)} \left(\frac{\lambda \pi_{LH} + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \right) \quad (63)$$

with ρ as the coefficient of correlation. This third term increases with ρ . When the latter reaches its maximum value ($\rho=1$), the expression (62) including the third term would become:

$$\frac{\sigma}{\pi_{LH}\beta(p_H^*-p_L^*)} + \frac{\lambda\pi_{LH} + \lambda\pi_{HL}}{1 + \lambda\pi_{LH} + \lambda\pi_{HL}} < 1 \quad (62')$$

Expressions (62) and (62') represent two extreme cases as far as the coefficient of correlation is concerned. The existence of a positive correlation between the two shocks constitutes an unfavourable factor for the selection of a free float. The conditions of existence of such a correlation as well as the policy implications are discussed in Edwards (1986).

3.4 Managed float: an intermediate case

We have seen that due to the anticipations of the economic agents, the nominal exchange rate does not respond as much as it would otherwise do, to the commodity price fluctuations. This raises the case for an active exchange rate policy which would aim at eliminating the smoothing effect mentioned earlier, making the exchange rate more variable to offset the external disturbances and to protect the domestic price level. The whole effect of the commodity price shocks will bear on the exchange rate exclusively.

In figure 3.3, the lines S_L^0 and S_H^0 represent the levels of the exchange rate in the absence of anticipations corresponding to the levels $p_c^*=p_L^*$ and $p_c^*=p_H^*$ respectively while S_L and S_H constitute the solutions in the presence of anticipations.

In terms of figure 3.3, the managed float consists of pushing back the lines S_L to S_L^0 and S_H to S_H^0 .

When such a policy is feasible, the variance of the domestic price is reduced to the variance of the money stock. In such circumstances, the managed float compares favourably with the

free float as far as price stability remains the main concern of the authorities. Indeed, in the managed float regime, the variance of the price level equals:¹⁴

$$Vp|_L = Vp|_H = \sigma^2 \quad (64)$$

Comparing equation (64) with (55) or (56), it is clear that the managed float indicated here will deliver a lower price variability than the pure float.

With respect to the fixed exchange rate regime compared with the managed float, the choice will depend on the ratio of the two variances:

$$\frac{\sigma^2}{\pi_{LH}\beta^2(p_H^* - p_L^*)^2}$$

which simply denotes the ratio of the money stock variance to the variance of the commodity price.

For an economy facing stochastic shocks, a managed float may be more appropriate rather than a free float or a fixed exchange rate if the external shocks prove more important than the internal shocks.

In sum, the calculations done above under different assumptions have shown that in contrast to the results using a standard

¹⁴ This can also be seen by noting from the arbitrage equation that: $dp = dS + \beta dp_c^*$
 $= (\partial S / \partial m) \sigma dz + (S_H - S_L) d\theta^* + \beta (p_H^* - p_L^*) d\theta$. The managed float ensures that $S_H - S_L = -\beta (p_H^* - p_L^*)$
 $\Rightarrow dp = (\partial S / \partial m) \sigma dz = \sigma dz \Rightarrow Vp = \sigma^2$

Brownian motion process, the Poisson process model enables us to identify an effect of terms of trade fluctuations on the domestic price level. That means that the flexible rate regime does not completely insulate the economy from external disturbance. As a result of this model the domestic price level will have a Poisson process component. In these conditions, the monetary authorities may adopt a managed float to achieve price stability. They would have to reinforce the appreciation of the exchange rate which occurs in response to a rise in terms of trade for example. Such a managed float is usually described as a policy of "leaning with the wind". It would seek to insulate completely the economy from external shocks. Williamson (1991b) points to this type of policy in the presence of expectations. In contrast, the domestic price will tend to be as volatile as the terms of trade if the exchange rate is fixed.

To some extent, the managed float which is suggested here would take the form of a commodity standard whereby an increase in the commodity price is offset by a deliberate action of the monetary authorities to complement the automatic appreciation on impact.

In practice, this takes the form of contractionary monetary policies when there is a boom in the commodity market and of an expansionary impulse when the commodity price falls. This would mean that fiscal surplus or deficits would be temporally allowed on the basis of expectations that the increase or decrease in the commodity price will be reversed, Blundell-Wignall & Gregory (1990).

We may represent the active monetary policy implied by the managed float by means of a reaction function for the monetary

authorities as follows:

$$m = m_0 - v\beta p_c^*$$

where m is the money supply with an average value of m_0 . The parameter v measures the intensity of the management policy to achieve the inflation target corresponding to m_0 . This specification implies that the managed float will take the form of a non-sterilized intervention. The rule is based on the movements of the commodity price. In a sense, it is easy to follow since the commodity price data are directly observable without great delay.

The standard model will be used for the determination of v . To do that we rewrite the reduced form of the monetary model (equation 17) in which m is replaced by its value above:

$$E(dS/dt) = \lambda^{-1}[S - m_0 + (1+v)\beta p_c^*] \quad (17')$$

The corresponding solutions for the exchange rate denoted by S_L^m and S_H^m prove to be:

$$S_L^m = m_0 - (1+v)\beta \left(\frac{1+\lambda\pi_{HL}}{1+\lambda\pi_{LH}+\lambda\pi_{HL}} p_L^* + \frac{\lambda\pi_{LH}}{1+\lambda\pi_{LH}+\lambda\pi_{HL}} p_H^* \right) \quad (65)$$

and

$$S_H^m = m_0 - (1+v)\beta \left(\frac{\lambda\pi_{HL}}{1+\lambda\pi_{LH}+\lambda\pi_{HL}} p_L^* + \frac{1+\lambda\pi_{HL}}{1+\lambda\pi_{LH}+\lambda\pi_{HL}} p_H^* \right) \quad (66)$$

The exchange rate will be managed so that its variations offset the change in the commodity price, taking account of the expectations. This means for example taking S_L back to $S_L = m_0 - \beta p_L^*$ as if there were no expectation effect. The corresponding value v_L of v , the degree of management appears equal to:

$$v_L = - \frac{(1-\omega_L)(P_H^* - P_L^*)}{\omega_L P_L^* + (1-\omega_L) P_H^*} \quad (67)$$

where:

$$\omega_L = \frac{1 + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \quad (44)'$$

Similarly, the managed float would return S_H to the value S_H^0 of the exchange rate corresponding to the high level of the commodity price (without expectation effect) by setting:

$$v = v_H = \frac{(1-\omega_H)(P_H^* - P_L^*)}{(1-\omega_H) P_L^* + \omega_H P_H^*} \quad (68)$$

with

$$\omega_H = \frac{1 + \lambda \pi_{LH}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \quad (45)'$$

This managed float together with the PPP relationship guarantees the constance of the domestic price $p_H = p_L = m_0$.

One may note that the degree of management v reflects directly the degree of anticipations as represented by the transition probabilities π_{LH} and π_{HL} and the semi-elasticity coefficient λ (the similarity of the latter with the transition probabilities has already been mentioned). It also reflects the relative position of P_H^* and P_L^* . Referring to diagram 3.3, we see that, assuming a symmetric representation, the position before intervention corresponds to the point I if the commodity price is at its low level and J if the commodity price is at its high level. The intervention will move the equilibrium to I' when starting from I, and to J' when starting from J. We have

at point I':

$$S_L^m = m_0 - \beta p_L^* \quad (69)$$

$$m_L^m = m_0 + \frac{(1 - \omega_L) (P_H^* - P_L^*)}{\omega_L P_L^* + (1 - \omega_L) P_H^*} \quad (70)$$

at point J':

$$S_H^m = m_0 - \beta p_H^* \quad (71)$$

$$m_H^m = m_0 - \frac{(1 - \omega_H) (P_H^* - P_L^*)}{(1 - \omega_H) P_L^* + \omega_H P_H^*} \quad (72)$$

where m_L and m_H denote the levels of money stock resulting from the intervention at positions L and H respectively.

The negative sign of v_L and the positive sign of v_H in equations (67) and (68) also confirm the nature of the managed float, namely an exchange rate policy of leaning with the wind.

With the managed float, and the equality of p_H and p_L as a

result it is possible to confirm that the variance of the price level will be reduced to variance of the money shocks. Indeed the differential equation of the domestic price gives:

$$dp = \partial p \backslash \partial m_0 \sigma dz + \pi_{LH}(p_H - p_L) d\theta^* = \sigma dz \quad (73)$$

which leads to:

$$Vp|_L = Vp|_H \equiv E(dp \backslash dt)^2 = \sigma^2 \quad (74)$$

We note that the interventions to appreciate or depreciate the exchange rate are non-sterilized.

Furthermore it is possible to get a sense of the exchange rate policy introduced here by recourse to the simplified model in its form of equations (1), (2) and (3). When the price level is targeted, then the value of the currency will change on a one-for-one basis with the commodity price according to the relationship (2). Let us assume the system starts from position $p_c^* = p_L^*$ and jumps to $p_c^* = p_H^*$. The agents will change their expectations. At the new position, they will be expecting a decrease in the commodity price level in period $t+1$, which implies, combining equations (1) and (2), that the real balances will tend to fall. This decrease in the real balances is brought about by the move of the nominal interest rate above the world rate for a while and correspondingly by the increase in the domestic price. To counter this rise in the domestic price, the monetary authorities will need to reduce the money supply, augmenting the initial appreciation of the exchange rate. The

interpretation of the policy action in the case of a fall in the commodity price p_c^* would follow similarly, implying an increase in the money stock.

3.5 Target zone

The literature on the choice for an exchange rate regime has for long concentrated on the comparison between the free float and the fixed exchange rate regimes. The target zone literature has opened up a third possibility usually viewed as an intermediary case.

The target zone scheme proposed here is deemed to suit very well the case of a small open economy facing two types of shocks: money disturbances and commodity price shocks. It will consist of setting a band for the exchange rate and to defend it as far as the money shocks are concerned but it will be adjusted upwards or downwards when the commodity price changes.

Setting a band and making it function as outlined seems to have an advantage. For a small economy with an undeveloped financial market, a fully free float may not be a real option. The presence of only a few participants and the little integration to the international market make the economy very vulnerable to speculations.

On the other hand, the experience about the exchange rate policies has clearly shown that the developing countries have had much difficulty in handling the system of fixed exchange rates with not frequent but very large devaluations. This has proven to be most destabilizing because these devaluations were preceded by severe balance of payments constraints and often forced by

speculative tensions on the financial market.

On both accounts, instituting a target zone would give more margin and prevent the building of speculative attack if the necessary shifts in the band are undertaken every time a commodity price occurs.

In addition, operating the target zone for the aim of price stability will clearly combine to a large extent the advantages of having a fixed rate to counter the money shocks and the advantages of the flexible rate to insulate the domestic price from the external disturbances.

In the following, the comparison will be carried out essentially between a target zone and a free float.

a. The model

The reduced form equation of the monetary model constitutes the starting point, rewritten as:

$$\lambda E dS/dt = S - m + \beta p_c^* \quad (17')$$

Application of Ito's lemma in its generalized form when both a Brownian motion process and a Poisson process are involved brings about, at position L and with the notations of the previous sections:

$$dS|_L = (\partial S / \partial m)|_L \sigma dz + (\partial^2 S / \partial m^2)|_L (\sigma^2 / 2) dt + (S_H - S_L) d\theta^* \quad (75)$$

Taking the expected value of (71) gives:

$$E(dS/dt)|_L = (\partial^2 S / \partial m^2)|_L (\sigma^2 / 2) + \pi_{LH} (S_H - S_L) \quad (76)$$

Substituting (72) into (17'), it follows:

$$S|_L = m - \beta p_L^* + \lambda (\sigma^2/2) S''|_L + \lambda \pi_{LH} (S_H - S_L) \quad (77)$$

where S'' denotes a second order differential.

Adopting and defending a currency band may involve a non-linearity graphically represented by a curve form to describe the exchange rate in function of the fundamentals, namely the money shocks. The non-linearity explains the presence of the second derivative term of S in the above expansion.

From equation (77), it follows that:

$$(1 + \lambda \pi_{LH}) S|_L = m - \beta p_L^* + \lambda (\sigma^2/2) S''|_L + \lambda \pi_{LH} S_H \quad (78)$$

Similarly at position H , we have:

$$(1 + \lambda \pi_{HL}) S|_H = m - \beta p_H^* + \lambda (\sigma^2/2) S''|_H + \lambda \pi_{HL} L S_L \quad (79)$$

To find the solutions of (78) and (79), we will look for, as in Perraudin (1990), a type of function with both a linear component and an exponential (non-linear) component:

$$S|_L = A_0 m + A_1 + A_2 \exp \alpha_1 m + A_3 \exp \alpha_3 m \quad (80)$$

$$S|_H = A_0 m + B_1 + B_2 \exp \beta_1 m + B_3 \exp \beta_3 m \quad (81)$$

where the coefficients A_i ($i=0,1,2,3$) and B_j ($j=1,2,3$) as well as the parameters α_1 , α_2 and β_1 , β_2 are to be determined. As far as the linear component is concerned, the same coefficient A_0 of the variable m can be in both S_L and S_H . With regards the other parameters, the S -curve (as known from the standard solution of

the target zone model) suggests to set the conditions:

$$\alpha_1 = \beta_1 ; \quad \alpha_2 = \beta_2$$

$$A_2 = B_2 \quad A_3 = B_3$$

Also $\alpha_1 = -\alpha_2$ since the money shocks have no drift. By substituting equations (80) and (81) into (78) and (79) one finds the conditions or equations determining the coefficients and parameters A_0 , A_1 , B_1 and α_1 .

$$A_0 = 1 \quad (82)$$

$$(1 + \lambda \pi_{LH}) A_1 = -\beta p_L^* + \lambda \pi_{LH} B_1 \quad (83)$$

$$(1 + \lambda \pi_{HL}) B_1 = -\beta p_H^* + \lambda \pi_{HL} A_1 \quad (84)$$

$$(1 + \lambda \pi_{LH}) = (\lambda \sigma^2 / 2) \alpha_1^2 + \pi_{LH} \quad (85)$$

Equations (83) and (84) determine A_1 and B_1 while equations (85) will give the parameter α_1 :

$$A_1 = -\beta \left[\frac{1 + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} p_L^* + \frac{\lambda \pi_{LH}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} p_H^* \right] \quad (86)$$

$$B_1 = -\beta \left[\frac{\lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} p_L^* + \frac{1 + \lambda \pi_{LH}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} p_H^* \right] \quad (87)$$

$$\alpha_1 = \left(\frac{2}{\lambda \sigma^2} \right)^{\frac{1}{2}} \quad (88)$$

The coefficients A_2 and A_3 are obtained via the "smooth-pasting" or tangency conditions.

b. The solutions

Before coming back to the tangency conditions, let us indicate the form of the solutions:

$$S_L = m - \beta \left[\frac{1 + \lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{\lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] + A_2 \exp \alpha_1 m + A_3 \exp -\alpha_1 m \quad (89)$$

$$S_H = m - \beta \left[\frac{\lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{1 + \lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] + A_2 \exp \alpha_1 m + A_3 \exp -\alpha_1 m \quad (90)$$

Not very surprisingly, the linear term of the solutions S_L or S_H equals the solution in the free float case.

The determination of the coefficients A_2 and A_3 requires that the boundary conditions be specified. These involve the upper (and lower) edges of the band and the values of the fundamentals where the curve representing the exchange rate will be tangential to the boundaries of the band (cf fig 3.4).

A number of notations have been adopted to illustrate the diagram 3.4. The band L represents the configuration of the currency band when the commodity price is at its low value p_L^* while the band H corresponds to the high level of the commodity price p_H^* . The values S_L^u and S_L^l are the upper and the lower edges of the band L: the corresponding points of tangency are located at $m = m_L^h$ and $m = m_L^l$ respectively, that is when the system rests on

the line S_L . A similar description applies for the band H.

When the Government announces the bands L and H which will characterize the exchange rate regime under the conditions of a commodity price boom or decline then it is possible to determine m_L^1 , m_L^h , m_H^1 and m_H^h . Using the expression (89) for S_L , we have:

$$S_L^1 = m_L^1 - \beta \left[\frac{1 + \lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{\lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] + A_2 \exp \alpha_1 m_L^1 + A_3 \exp -\alpha_1 m_L^1 \quad (91)$$

$$S_L^h = m_L^h - \beta \left[\frac{1 + \lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{\lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] + A_2 \exp \alpha_1 m_L^h + A_3 \exp -\alpha_1 m_L^h \quad (92)$$

Equations (91) and (92) give m_L^1 and m_L^h respectively in function of S_L^1 and S_L^h which are determined by the monetary authorities. Similar equations apply for the determination of m_H^1 and m_H^h using the expression (90) of S_H .

Coming back to the smooth-pasting conditions, they may be written for S_L :

$$1 + \alpha_1 A_2 \exp \alpha_1 m_L^h - \alpha_1 A_3 \exp -\alpha_1 m_L^h = 0 \quad (93)$$

$$1 + \alpha_1 A_2 \exp \alpha_1 m_L^1 - \alpha_1 A_3 \exp -\alpha_1 m_L^1 = 0 \quad (94)$$

It follows that the coefficients A_2 and A_3 can be obtained using the expressions:

$$A_2 = \frac{1}{\alpha_1} \frac{\exp -\alpha_1 m_L^h - \exp -\alpha_1 m_L^1}{\exp \alpha_1 (m_L^h - m_L^1) - \exp -\alpha_1 (m_L^1 - m_L^h)} \quad (95)$$

$$A_3 = \frac{1}{\alpha_1} \frac{\exp \alpha_1 m_L^l - \exp \alpha_1 m_L^h}{\exp \alpha_1 (m_L^h - m_L^l) - \exp \alpha_1 (m_L^l - m_L^h)} \quad (96)$$

As expected, it appears that the coefficient A_2 is negative while A_3 is positive. This explains the S-shaped form of the curve S_L and S_H in figure 3.4.

c. Anticipations and interventions.

(i) Interventions inside the band

This case corresponds to the solutions obtained where the interventions are limited to keep the exchange rate inside the band in response only to monetary shocks. Let us look at figure 3.4 again to comment on some particular features. The exchange rate is driven by a continuous stochastic process via the money shocks and from time to time by discontinuous changes due to the commodity price fluctuations. The exchange rate policy consists of letting the exchange rate move freely between the points A and A' when the commodity price is at its high level or between the points B and B' when the commodity price is at its low level. Any change in p_c^* will automatically provoke a shift from the curve S_L to the curve S_H and a corresponding shift in the band from band L to band H, or vice-versa. McKinnon (1971) has suggested the need for an adjustable band in an unstable context. This intervention policy which deals differently with the external shocks and the monetary shocks supposes that one can distinguish the two categories of shocks. Aizenman & Frenkel (1982) raise the issue of signal extraction which may arise in practice.

But let us assume that the exchange rate moves along, for example S_H , then it will be restrained to remain inside the band H. At point A (or A'), the monetary authorities will stand to defend it not to depreciate (or not to appreciate) any more. When the commodity price drops from p_H^* to p_L^* , then the exchange rate will move vertically into the band L. The size of this jump in the exchange rate is independent of m in this specific form of intervention and equals the distance $d = S_L - S_H$.

(ii) Combining managed float and target zone.

The monetary authorities aim to protect the domestic price. Consequently they will seek to offset the dampening effect on the exchange rate of anticipations about the commodity price in foreign currency. This managed float can be combined with the target zone, leading to the situation described in fig 3.5. There is similarity with fig 3.4 but here the variable m changes as a result of the offsetting operation. The corresponding solutions denoted S_L^c and S_H^c can be easily derived by analogy from equations (89) and (90) where we replace m by m_L and m_H respectively (these correspond to the level of money taking into account the monetary rule and have been defined in equations (70) and (72) above):

$$S_L^c = m_L - \beta \left[\frac{1 + \lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{\lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] + A_2 \exp \alpha_1 m + A_3 \exp -\alpha_1 m_L \quad (93)$$

$$S_H^c = m_H - \beta \left[\frac{\lambda \cdot \pi_{HL}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_L^* + \frac{1 + \lambda \cdot \pi_{LH}}{1 + \lambda \cdot \pi_{LH} + \lambda \cdot \pi_{HL}} p_H^* \right] + A_2 \exp \alpha_1 m_H + A_3 \exp -\alpha_1 m_H \quad (94)$$

d. Target zone versus free float.

As before the relative merits of the two regimes will be assessed with reference to the criterion of price stability. We know from the standard model where no foreign price shocks are present, with only money shocks that the target zone leads to more stability of the exchange rate than the free float. Adding the commodity price shocks and letting the exchange rate respond freely to the foreign price fluctuations will constitute an additional source of variability in the exchange rate, in both regimes. A sense of that can be easily seen by looking at the difference between the exchange rates at positions Low and High, difference directly associated with the relative positions of p_L^* and p_H^* :

$$S_L - S_H = \frac{1}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \beta (p_H^* - p_L^*) \quad (97)$$

This represents the size of the jump in the exchange rate, associated with the jump in the commodity price, in the free float regime. The higher degree of variations in the exchange rate would result in less variation of the price level:

$$p_H - p_L = S_H + \beta p_H^* - (S_L + \beta p_L^*) = \beta (p_H^* - p_L^*) - (S_L - S_H) \quad (98)$$

Let us now determine the variance as a more appropriate

$$p_H - p_L = \frac{\lambda\pi_{LH} + \lambda\pi_{HL}}{1 + \lambda\pi_{LH} + \lambda\pi_{HL}} \beta (p_H^* - p_L^*) \quad (99)$$

indicator of the price variability, considering first the target zone with interventions limited to defend the band. Later the combined case will be considered.

The differential formula applies to the domestic price:

$$dp|_L = (\partial p / \partial m)|_L \sigma dz + (\partial^2 p / \partial m^2)|_L (\sigma^2 / 2) dt + (p_H - p_L) d\theta^* \quad (100)$$

The variance is obtained as:

$$E(dp)^2 / dt|_L = (\partial p / \partial m)^2|_L \sigma^2 + \pi_{LH} (p_H - p_L)^2 \quad (101)$$

$$\text{with } \partial p / \partial m|_L = \partial S / \partial m_L = 1 + \alpha_1 A_2 \exp \alpha_1 m - \alpha_1 A_3 \exp -\alpha_1 m < 1 \quad (102)$$

To introduce the comparison with the free float, let us note that the first term in (101) represents the variance of the exchange rate in the case of a target zone with only money shocks operating. Expressing the fact that the target zone provides more stability for the exchange rate than the free float in the conditions of only money shocks prevailing can be done as follows, from equation (102):

$$(\partial S / \partial m)^2|_L \sigma^2 < \sigma^2 \quad (103)$$

Or equivalently:

$$(\partial p / \partial m)^2|_L \sigma^2 < \sigma^2 \quad (104)$$

Then it follows that:

$$E(dp)^2 / dt|_L < \sigma^2 + \pi_{LH} (p_H - p_L)^2 \quad (105)$$

But looking at equation (99) which gives the expression of $p_H - p_L$, we can write:

$$\frac{E(\dot{p}^2)}{dt} \Big|_t < \sigma^2 + \pi_{LH} \left(\frac{\lambda \pi_{LH} + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \right)^2 \beta^2 (p_H^* - p_L^*)^2 \quad (106)$$

The right hand side of (106) represents in fact the variance of p in the free float regime (having ignored the correlation term). This establishes that the target zone provides price stability better than the flexible rate regime.

The calculations above concerned the case where $p_c^* = p_L^*$. But the same results apply for the case where $p_c^* = p_H^*$. The target zone is referred to here in the sense of a currency band with defence in response to monetary shocks which may drive the exchange rate out of the band but realignments will be the normal response to commodity price shocks. The target zone gives more price stability than the free float for two reasons:

- in face of monetary shocks, more stability of the exchange rate means more stability of the domestic price.
- when jumps in the commodity price occur , then the exchange rate is let free to respond as in the free float.

Consequently, the domestic price will display less variability. It will display even less variability when we combine the target zone with the managed float. More precisely this combination will ensure that the domestic price is completely insulated from the commodity disturbances. Under these circumstances, the only source of uncertainty affecting the domestic price will be the

money shocks, and the variance will be reduced to (cf equation 101):

$$E(dp^2)/dt = (\partial p/\partial m)^2|_L \sigma^2$$

Indeed fig 3.5 indicates that the jump in the exchange rate will always equal:

$$S_L^c - S_H^c = m_0 - \beta p^{L*} - (m_0 - \beta p_H^*) = \beta (p_H^* - p_L^*)$$

$$\begin{aligned} \text{This gives from equation (98): } p_H^c - p_L^c &= S_H^c + \beta p_H^* - (S_L^c + \beta p_L^*) \\ &= S_H^c - S_L^c + \beta (p_H^* - p_L^*) = 0 \end{aligned}$$

3.6 Basket peg

The basket peg has become much more adopted as an exchange rate regime by developing countries. Many of these shifted from a single currency peg to a basket peg in the aftermath of the large fluctuations between major currencies in the early 1970's. The basket peg consists of stabilizing the effective exchange rate for a given country. The SDR which constitutes a basket of the key currencies is usually taken to approximate the effective exchange rate.

The adoption of a basket peg involves methodological and operational issues discussed by Williamson (1982) and Takagi (1987), especially about the criteria for an optimal peg and the weighting necessary to compute the effective exchange rate.

In the following, the basket peg will be compared with the single currency peg. The latter is usually referred to as the fixed rate regime. In fact there exist different sorts of pegs: the fixed peg and the crawling peg constitute two main categories. The fixed peg includes the single currency fixed rate and the basket fixed peg. The two sub-categories also apply for the crawling peg. The crawling peg is the case where the nominal

exchange rate is continuously changed to offset the inflation differential vis-a-vis the trade partners.

The fixed peg seems more appropriate than the crawling peg in the present context where price stability represents the basic criterion.

a. A three-country model

To introduce the basket peg let us consider a model with three economies:

- the domestic economy which is a small open commodity-exporting economy
- a large country A and a small country B with the following characteristics:
 - i) the exchange rate of A is not affected by a change in the commodity price. Country A would be the USA or the EC.
 - ii) B is a commodity-exporting economy. Its exchange rate responds to change in the commodity price. We might think of the economy B as representing the group of trading partners among other developing countries.

Let us adopt the following notations:

m : money supply in the domestic economy

P_c^* : the world commodity price expressed in country A currency.

P_{OT}^* : the price of other tradables in country A currency.

β : share of the commodity sector in the domestic economy.

β' : share of the commodity sector in the economy B

x : share of country A in the external trade of the small economy

1-x: share of country B in the external trade of the small economy

S_A : the bilateral exchange rate with respect to A

S_B : the bilateral exchange rate with respect to B

In the context of the monetary model the reduced form is known to be:

$$E(dS/dt) = \lambda^{-1}(S - m + \beta P_c^* + (1 - \beta) P_{oT}^*) \quad (107)$$

P_{oT}^* will be set to zero so that to focus on the changes in the commodity price P_c^* .

Then the above reduced form will give the following:

$$S_A = m - \beta P_c^* \quad (108)$$

As regards S_B , the triangular arbitrage gives:

$$S_B = S_A - S_{BA} \quad (109)$$

where S_{BA} represents the exchange rate of country B currency with respect to the reference currency.

Just as in equation (108), we have:

$$S_{BA} = m_B^* - \beta' P_c^* \quad (110)$$

where m_B^* denotes the money supply of country B. It will be considered as exogenous and normalized to zero as well¹⁵.

¹⁵ Setting $m_B^* = 0$ while variations of p_c^* are considered implies that there is no correlation between the commodity price shocks and the money shocks in economy B.

Then we can write:

$$S_B = S_A - S_{BA} = m - \beta P_c^* + \beta' P_c^* = m - (\beta - \beta') P_c^* \quad (111)$$

Equation (111) indicates that the response of the bilateral rate vis-a-vis country B will depend on the relative importance of the commodity sector in country B compared with the domestic economy. For example an increase in the world price of the commodity will entail an appreciation of the domestic currency with respect to the key currency A. But it will do the same for the currency B with respect to the same currency A. Then the bilateral rate of the domestic currency with respect to the currency B will appreciate or depreciate depending on the relative importance of the export sector in the two economies: it will appreciate if the domestic economy has a commodity sector more important than economy B ($\beta > \beta'$) and conversely it will depreciate if the commodity sector is less important in the domestic economy ($\beta < \beta'$).

The index of the effective exchange rate is defined as:

$$S = xS_A + (1-x)S_B \quad (112)$$

This gives:

$$S = m - [\beta - (1-x)\beta'] P_c^* \quad (113)$$

The same comment as on equation (111) applies to equation (113), defining the effective exchange rate of the domestic economy except for taking into account the trade partnership with country

B.

The corresponding index of the commodity price in the currency of country A should be consistent with the PPP rule in the context of the monetary model. The following index:

$$x(\beta P_c^*) + (1-x)(\beta - \beta') P_c^* = [\beta - (1-x)\beta'] P_c^* \quad (114)$$

proves to satisfy that condition in the sense that if the commodity price P_c^* rises, the nominal (effective) exchange rate will appreciate sufficiently so as to leave the domestic price unchanged. Likewise a one-to-one nominal depreciation will occur in response to a decrease in P_c^* .

Consequently, the domestic price via the PPP rule takes the form:

$$P = S + [\beta - (1-x)\beta'] P_c^* \quad (115)$$

Then the monetary model for a three-country world will be described with the three equations:

$$m - P = -\lambda i \quad (1'')$$

$$P = S + [\beta - (1-x)\beta'] P_c^* \quad (2'')$$

$$i = E(dS/dt) \quad (3'')$$

where: i represents the nominal interest rate and λ denotes the interest rate semi-elasticity of the demand for money. The main point derived so far relates to the form of equation (2'') which defines the PPP rule in the context of a three country model.

The reduced form of this system of equations appears to be:

$$E(dS/dt) = \lambda^{-1}(S-m+\omega P_c^*) \quad (17'')$$

in which relationship ω is derived from β and β' : $\omega \equiv \beta - (1-x)\beta'$. Let us assume that ω is positive since this does not seem to be a very restrictive assumption. Note that in a two-country model with a single key currency, ω would become β . This parallels the case where country B does not trade very much with the small economy in comparison with A, and consequently $(1-x)$ will be low and ω will tend towards β .

b. The results

i) Solutions for the exchange rate and the domestic price.

If P_c^* follows a Poisson process and takes on two values only P_L^* (low) and P_H^* (high) as previously assumed, the reduced form:

$$E(dS/dt) = \lambda^{-1}(S-m+\omega P_c^*)$$

leads to:

$$\pi_{LH}(S_H - S_L) = \lambda^{-1}(S_L - m + \omega P_L^*) \quad (116) \quad \text{at position } P_c^* = P_L^*$$

$$\pi_{HL}(S_L - S_H) = \lambda^{-1}(S_H - m + \omega P_H^*) \quad (117) \quad \text{at position } P_c^* = P_H^*$$

In the context of the free float, solving this two-equation system gives S_L and S_H and combining with the PPP equation (115) entails:

$$P_L = m - \frac{\lambda \pi_{LH}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \omega (P_H^* - P_L^*) \quad (118)$$

$$P_H = m + \frac{\lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \omega (P_H^* - P_L^*) \quad (119)$$

It follows that:

$$P_H - P_L = \frac{\lambda \pi_{LH} + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \omega (P_H^* - P_L^*) \quad (120)$$

These expressions correspond to the flexible rate regime and can be used for further calculations.¹⁶ They display much similarity with the solutions of the two-country model (equations 46 to 48), the parameter ω replacing the parameter β . After having established the three country framework, we can now proceed to compare the single currency peg and the basket peg

ii) Price variability

We distinguish the two types of fixed rate regimes: the basket peg and the single currency peg.

For the basket peg, the effective exchange rate S is constant and is taken as zero. It results that:

$$P = S + \omega P_c^* = \omega P_c^* \quad (121)$$

¹⁶ To compare with the variances in equations (122) and (125), one may note that the variances of the domestic price in the free float and managed float (at position L) are respectively:

$$E(dp^2) \frac{dt}{dt} \Big|_L = \sigma^2 + \pi_{LH} \left(\frac{\lambda \pi_{LH} + \lambda \pi_{HL}}{1 + \lambda \pi_{LH} + \lambda \pi_{HL}} \right)^2 \omega^2 (P_H^* - P_L^*)^2$$

$$E(dp)^2 / dt \Big|_L = \sigma^2$$

Since P_c^* follows a Poisson process, the variance of the domestic price P will be:

$$E(dP)^2/dt_L = \omega^2 \pi_{LH} (P_H^* - P_L^*)^2 \quad (122)$$

For the single currency peg, it consists of a fixed rate peg to the currency of A, implying that $S_A = 0$ and consequently:

$$S = (1-x)S_B = (1-x)\beta'P_c^* \quad (123)$$

and

$$P = [\omega + (1-x)\beta']P_c^* = \beta P_c^* \quad (124)$$

The variance of P can then be derived as:

$$E(dP)^2/dt_L = \beta^2 \pi_{LH} (P_H^* - P_L^*)^2 \quad (125)$$

These two variances involve only the variance of the commodity price and can be easily compared. The conclusion will be that the fixed rate basket peg gives a lower variance than the fixed rate single currency peg (to country A currency) since $\omega = \beta - (1-x)\beta'$ is less than β . In the single currency peg, a commodity price fluctuation will fully translate into changes in the domestic price taking account of the share of the commodity sector in the domestic economy. Extending the peg to currency B in a basket peg regime means that the bilateral rate with respect to country B will change somewhat following a commodity price jump because the currency B will respond to that jump: the latter will appreciate and lead to a depreciation of the bilateral rate S_B . Consequently

it will tend to depreciate the effective exchange rate from its initial level in the proportion $\beta'(1-x)$. To keep the effective rate fixed, one will have to appreciate the bilateral rate S_A for the same amount. The domestic price is insulated from the external disturbance to the extent of this appreciation in comparison with the single peg.

$$\omega = \beta - (1-x)\beta' < \beta$$

Therefore the variance of the domestic price is lower in the basket peg regime than in the single currency peg regime. This preference for the basket peg results in part from our focus on macro-stability instead of micro-stability. The latter criterion may give some advantage to the single currency peg as described in Black (1976), in the sense that it presents the traders with virtually no risks with regards the link with the intervention currency but it raises macroeconomic risks in the sense that fluctuations between the key currencies will represent an external shock for the small economy. Conversely the flexible rate or the basket peg will eliminate this category of macroeconomic risk while it may introduce some uncertainty for the traders about the exchange rate to use for their transactions.

c. Extension: taking account of the key currency variations

The fluctuations between the key currencies during the 1970's and 1980's and even more recently had been a feature of the international monetary system. For a small country which adopts a peg regime, the fluctuations may constitute a major foreign disturbance. To add in this particular aspect, the three-country

model of the previous subsection is extended and becomes a four-country model. The fourth country is taken to be a large country. In sum, beside the domestic economy which continues to be characterized as a small open and commodity-exporting one, we have another small commodity-exporting economy and two large economies (e.g. US and EC or Japan). Variations in the exchange rate between the two large countries are assumed to occur very significantly.

Rewriting the model, we have as before:

$$S_A = m - \beta \cdot P_c^* \quad (126)$$

$$S_B = S_A - S_{BA} = S_A + \beta' P_c^* = m - (\beta - \beta') P_c^* \quad (127)$$

The bilateral rate with respect to the second large country C will be:

$$S_C = S_A - S_{CA} \quad (128)$$

where S_{CA} represents the bilateral rate between the two large countries and will be denoted by the variable f . Therefore, we have:

$$S_C = m - \beta P_c^* - f \quad (129)$$

If the trade shares are x_A , x_B and $1 - x_A - x_B$, the effective exchange rate will equal:

$$S = x_A S_A + x_B S_B + (1 - x_A - x_B) S_C \quad (130)$$

or equivalently:

$$S = m - (\beta - x_B \beta') P_c^* - (1 - x_A - x_B) f \quad (131)$$

Now the expression of the effective exchange rate has an additional term resulting from the introduction of the variable f (key currency fluctuations). The latter will affect the domestic currency as an external disturbance in a similar way as the world price of the commodity.

On the other hand, for the PPP rule to hold, the domestic price should take the form:

$$P = S + (\beta - x_B \beta') P_c^* \quad (132)$$

i) The single currency peg

If the domestic economy pegs its currency to the currency of country C then $S_C = 0$ and $S_A = S_{CA}$

Under these conditions, the effective exchange rate reduces to its first two terms in (130) so that:

$$S = x_A S_A + x_B S_B = x_A S_{CA} + x_B (S_{CA} + \beta' P_c^*) \quad (133)$$

$$\text{or} \quad S = (x_A + x_B) f + x_B \beta' P_c^* \quad (134)$$

It will follow that the domestic price in the case of a single currency peg will be:

$$P = (x_A + x_B) f + \beta P_c^* \quad (135)$$

The domestic price will vary in function of the changes in not only the commodity price but also the bilateral rate between the

key currencies as well. We will assume that the variable f follows a random walk process. Under these conditions and assuming that the commodity price shocks and the key currency shocks are independent, the variance of the domestic price equals:

$$VP_{|L} = \beta^2 \pi_{LH} (p_H^* - p_L^*)^2 + (x_A + x_B)^2 \sigma_f^2 \quad (136)$$

where σ_f^2 denotes the variance of the shocks corresponding to the currency fluctuations.

ii) The basket peg

We set $S = 0$ to represent the basket peg which leads to:

$$P = (\beta - x_B \beta') P_c^* = \omega P_c^* \quad (137)$$

Consequently, the variance of the domestic price equals:

$$VP_{|L} = \omega^2 \pi_{LH} (p_H^* - p_L^*)^2 \quad (138)$$

The comparison between the two types of peg amounts to comparing the variances in (136) and (138). The simple currency peg is less satisfactory than the basket peg, even more clearly in this case where the key currency variations are introduced and prove to be external disturbances affecting the small open economy. The reason is because it fails to protect the domestic price from both external shocks while the basket peg insulates completely from the f shocks and partially from the commodity price shocks.

Conclusion

The role that expectations can play among the determinants of the exchange rate is one of the features underlined by the modern strand of the literature on exchange rate economics. We have wanted to illustrate this by introducing a Poisson process to describe the behaviour of the export commodity price or more generally the terms of trade that the small economy faces. When the monetary authorities aim to stabilize the domestic price level, then the results of the model suggest a policy of "leaning with the wind" for the exchange rate, corresponding to a contractionary (expansionary) monetary policy to be undertaken in a period of commodity price boom (bust). The specification of the Poisson process has been simplified as much as possible where the commodity price takes on two values only (High and Low). But the policy implications would be the same in a more complex specification of the Poisson process.

We have also addressed the question of choice for an exchange rate regime. It appears that the managed float as well as a currency band present some advantages compared with the free float in this small open economy subject to monetary and external shocks. On the other hand, it is shown that the basket peg should dominate the single currency peg. Then the question arises whether it is feasible to combine the features of basket peg, managed float and target zone as a way to obtain the most optimal exchange rate regime. In principle, there is no conceptual difficulty in doing so. The way to combine the managed float and the target zone has been investigated above. Furthermore,

considering the target zone, one needs only to set it using a basket instead of a single currency as the unit. Typically the edges of the band would relate to the effective exchange rate and not the bilateral rate. Secondly the band will be managed. This means that with respect to the monetary shocks, the band will be defended as usual (if necessary the band width will be zero). But when commodity price shocks occur, the monetary authorities will proceed to a realignment, shifting the band consequently (cf section 3.5). This managed float will protect the domestic price from the external disturbances: it does not limit itself to shifting the band, it takes into account the effects of anticipations in the exchange rate and the domestic price.

One can note the highly stylised nature of the model, leading to the proposal that the currency band be shifted to two positions High and Low respectively, in response to an increase or decrease in the commodity price. In the general case where the commodity price takes on many more values, the policy implication reminds of the crawling peg policy. Here the crawling peg will be with respect to the commodity price or equivalently the terms of trade. The conventional crawling peg refers to the differential between domestic and foreign inflation. We can note that the two concepts would coincide if the terms of trade were defined to mean the foreign price relative to the domestic price. A crawling peg which has the form of a commodity standard will ensure that the real exchange rate adjusts to external shocks and at the same time promote price stability as far as these external shocks are concerned.

We have assumed that a problem of signal extraction does not

arise in this model so that the monetary authorities can decide about the action the most appropriate to external shocks as distinct from monetary shocks.

CHAPTER 4. THE BG/SD MODEL

Introduction

The study of exchange rate regimes offers two ways of approaching the problem of choosing the optimal regime. One way which is most used in the literature consists of specifying a monetary rule whose parameters determine how the exogenous shocks hitting the economy affect the ultimate objectives. Blundell-Wignall and Gregory (1990) referred henceforth as BG have used this method . They offer a model to analyze the choice of an exchange rate regime. The analysis bears on the case of Australia and New-Zealand. But the model may be viewed as representative of any country which can be characterized as essentially a commodity-exporting economy. The authors have established a clear-cut result which gives the relationship between the real exchange rate and the terms of trade. Then they proceed to the question of an optimal exchange rate regime. For this purpose, price stability is chosen as the optimality criterion. Using a reaction function to describe the monetary rule, the analysis comes to the conclusion that where external disturbances are more important compared with internal disturbances, a flexible exchange rate should be preferred to a fixed rate and vice-versa (i.e. a fixed rate regime should be adopted in the case where internal shocks are relatively more important).

An alternative and more direct way to deal with the problem of

the choice of an optimal exchange regime would involve calculating the variances for the target variable under only two regimes, a fixed rate on the one hand and under a flexible rate on the other. One can then compare these variances and select the optimal regime, on the basis of the price stability criterion for example.

By means of stochastic calculations, we use the second approach which, when applied to the BG model leads to more precise results. Furthermore, it is shown how the Poisson process specification may be introduced. In the present chapter as in the previous chapter and, we retain price stability as the objective function of the monetary authorities.

The first section will present the extended model. Section 4.2 will determine the solutions and the dynamics. In section 4.3, we consider the economy under shocks. Under the stochastic setting, the alternative regimes of float and fixed rate are compared. A numerical illustration follows in section 4.4. The last section introduces the Poisson process.

4.1 The BG specification

Here we present a version of the BG model in which a few modifications have been introduced: the reaction function defining the monetary rule does not enter any longer. Also the equation which describes in an ad-hoc way the dynamics of the real exchange rate is deleted since such dynamics can be derived from the rest of the model, using the saddlepoint technique. Furthermore we translate the discrete time form of the model into a continuous-time setting in order to apply the stochastic

analysis.

The main characteristic of the model considered here relates to the emphasis it gives to the role played by the primary good or commodity. In that sense, it presents a great similarity with the simplified model of the previous chapter. The main novelty in the present representation is the introduction of a non-traded good, whereby the structural parameters can be displayed.

As it stands, the model in continuous time is basically a modified Dornbusch model in which the goods sector has been extended. The PPP rule is assumed to hold for traded goods, both manufactured and primary commodities. The non-traded good price however is determined by the situation of demand and supply on the domestic market.

The model consists of the following set of equations:

$$m - p_d = \gamma(p + y_0 - p_d) - \varepsilon i \quad (1)$$

$$i = i^* + E(dS/dt) \quad (2)$$

$$y_x = \eta(S + p_x^* - p_n) + y \quad (3)$$

$$Y_0 = Y_x + Y_n \quad (4)$$

$$d = p - p_d + Y_0 \quad (5)$$

$$d_n = \alpha(S + p_m^* - p_n) + d \quad (6)$$

$$D_m = D - D_n \quad (7)$$

$$p = \lambda p_n + (1 - \lambda)(S + p_x^*) \quad (8)$$

$$p_d = \lambda p_n + (1 - \lambda)(S + p_m^*) \quad (9)$$

$$dp_n = \phi(d_n - y_n)dt \quad (10)$$

The notations are as follows: all variables are in natural logarithms except the variables in capital letters and the

interest rate. So $y_0 = \log Y_0$ and $p = \log P$ for example. Variables such as y_0 and p_x^* are assumed to be exogenous. The other ten variables constitute the endogenous variables which can be derived from the set of equations. The other notations consist of the following:

y_x , y_n and y_0 : supply of exports in the proportion $(1-\lambda)$, of the non-traded good in the proportion λ and of total (and full employment level) output (evaluated at their price in the previous period, which is assumed to be equal to unity)¹.

d_n , d_m and d : non-traded goods demand, import demand and total demand.

p , p_d , p_n and p_x^* : GDP deflator, demand deflator, price index of the non-traded good and export price (p_x^* is in foreign currency).

p_m^* : import price index in foreign currency, normalized to zero in the subsequent analysis.

S and $E(ds/dt)$: the nominal exchange rate (domestic currency per unit of foreign currency) and its expected depreciation.

m : money stock

i and i^* : domestic and foreign interest rates.

All parameters are deemed to be positive. To clarify the sense of equation (3) and equation (6), one may need to add a negative constant on the right hand side. Indeed these two equations aim at giving the determinants of the production share (%) of the commodity sector and the demand share (%) of the non-traded good respectively. Such a constant is omitted here.

¹ $P^0 Y_0 = P_x^0 Y_x + P_n^0 Y_n$ where P_x^0 and P_n^0 are the previous period prices normalized to unity.

The analysis of the terms of trade shocks generally requires the set-up of a three goods framework as a minimum. The model specified above includes three goods, but there are restrictions in what is produced and consumed domestically. Only two of the three goods are produced domestically, the primary commodity which is exported and the non-traded good. Basically, it pictures the case of a dependent economy a la Salter (1959). As Salter (1959) explains in building his model for a dependent economy, importables might be viewed as a category of exports, the receipts of which will be used to buy imports for an amount equivalent to the would-be domestic production of importables².

Table 4.1

a) Composition of production and consumption
(showing the price of production and consumption)

<u>Production</u>		<u>Consumption</u>	
<u>Commodity</u>	<u>Non-traded good</u>	<u>Imports</u>	<u>Non-traded good</u>
$y_x (p_x^* + S)$	$y_n (p_n)$	$d_m (p_m = S + p_m^*)$	$d_n (p_n)$
		(with $p_m^* = 0$)	

.....

b) Deflators of production and consumption

<u>Production (GDP)</u>	<u>Consumption (CPI)</u>
$p = \lambda p_n + (1 - \lambda) (p_x^* + S)$	$p_d = \lambda p_n + (1 - \lambda) S$

² We note that the construction of the tradable good as a composite good holds as long as the relative prices of exports and imports do not change.

c) Terms of trade

$$P_x - P_m = P_x^*$$

d) Real exchange rate

$$S - p_n$$

.....
..

The tradable sector is thus divided into the exports which are domestically produced and imports which are not. It is assumed that domestic demand has only two components: demand for the non-traded good and demand for imports. The tradable sector produces for the foreign good market only and the needs for tradables are met by imports.

These assumptions on production and consumption can be relaxed by interpreting the equations in terms of excess demand and supply terms. The level of imports can be given the interpretation of excess demand for the importable over the domestic production of the same good. Similarly, the level of exports could represent the excess supply of the commodity good with respect to the domestic demand for the same good. It can be easily seen that the way the excess demand for, and the excess domestic production of, these goods will respond to a boom is consistent with the specification of equations (3) and (6). But note that the exclusion restrictions are now much harder to justify.

Equations (1) and (2) represent the asset market equilibrium and the arbitrage equation equalizing the expected returns on the domestic and foreign assets. The parameter ε (notice the change in the notations from the previous chapter) represents the semi-elasticity of the demand for money with respect to the interest rate. These two equations determine the domestic price p_a and the interest rate i respectively.

Equations (3) to (7) describe the goods sector supplies and demands. Under the assumptions of a small open economy, the domestic demand for imports and supply of exports have no effect on the world price of these goods, that is to say that the world supply of the good which is demanded for by the small economy, as well as the world demand for the good supplied by the small economy are infinitely elastic. The assumption therefore enables us to treat p_x^* and p_m^* as exogenously determined.

Equations (3) to (6) involve what will be referred to as the substitution and income effects. We give below a brief presentation of these categories of effects before proceeding with the description of the other equations of the model.

a. The substitution effect in production.

The supply of the commodity good (all of which is exported) as a proportion of the overall output will increase with the price of the commodity relative to the non-traded good. This represents the substitution effect between the two sectors in response to changes in the relative prices. The supply elasticity η measures the degree of substitutability. Fig 4.1 below gives a graphic representation of the substitution process. The curve AB

indicates the possibility frontier of the production function. The total of resources used in the production is assumed to be fixed and the economy reaches its full employment level along the frontier. The lines TT and T'T' denote two levels of the relative price of the non-traded good with respect to the commodity good. The relative price at the equilibrium point E' is more favourable to the commodity sector than at point E, which consequently attracts more resources and a higher production level of the commodity good at the expense of the non-traded good: $y_x^2 > y_x^1$ and $y_n^2 < y_n^1$.

These substitution effects correspond to the "resource movement" effect in the "Dutch disease" literature³.

We note that when the exchange rate is flexible, the change in the price (in domestic currency) of the commodity good will be the net result of the change in the world price of the commodity and the change in the exchange rate, whether the former induces the latter or not.

b. The income effect

The aggregate demand and the demands directed to the non-traded good and to the imports are described in equations (5) to (7). Equation (5) states that the aggregate demand is simply nominal income deflated by the demand deflator, defined in equation (8). While this specification is undoubtedly very simplified, it does however take into account the income effect of the terms of trade. An improvement in the terms of trade will translate into

³ The Dutch problem, that is the shrinkage of the importable sector following a boom in the commodity sector is dealt with more specifically in the next chapter.

more real income and consequently more demand. Note that what is identified here as the income effect is also known as the "spending effect" in "Dutch disease" and dependent economy models.

We note that it is the aggregate demand defined this way which enters the demand for money in equation (1). Also, one may see that specifying the GDP deflator (equation 8) and domestic demand deflator (equation 9) separately has made it possible to derive the income effect, which justifies the set of three goods prices in the model.

We note that equation (6) involves the real exchange rate defined as the relative price of the import good with respect to the non-traded good. With the chosen normalization ($p_m^* = 0$), the real exchange rate amounts to the difference between the nominal exchange rate and the price of the non-traded good. Equation (6) indicates that the non-traded good component of demand depends positively on the real exchange rate.

In view of the possible application of the model to the Franc Zone (FZ) countries, the asymmetry between the small and the large country will be essentially represented by the underlying assumption that any change in the commodity price will affect the domestic economy but conversely the latter cannot influence the world prices or other variables of the large economy.

Let us further consider the adjustment process implied in the income effect with the curve of fig 4.2. This incorporates the production possibilities curve from fig 4.1, but also includes an indifference curve UU between d_n and d_m , where the vertical axis measures both y_x and the value of imports which can be

purchased at given terms of trade. The supply of the commodity sector and demand for imports are measured on the vertical axis, the supply of, and demand for the non-traded good, on the horizontal axis. The effect of a commodity price change acts as an income effect which shifts the curve of available goods from MN to $M'N$ and the indifference curve to a new position $U'U'$. The situation before any change in the nominal exchange rate S or the non-traded good price p_n can be pictured as at B . The point B represents the volume of goods available at the new terms of trade, point C represents the desired demand for goods, following the increase in the terms of trade. At C , the relative price LL (of imports with respect to the non-traded good) remains the same as at the beginning, and desired demand for goods has increased. Comparing with the volume of goods available at B , it appears that the volume of imports which can be bought at the new terms of trade exceeds the demand for imports while there is excess demand for the non-traded good. For equilibrium to be restored (at point D), there will be a change in the relative prices¹². The price of imports will decrease, and the price of the non-traded good will increase, which means an appreciation of the exchange rate, as a result of the terms of trade rise. This will lead to an appreciation of the real exchange rate.

A similar illustration of the adjustment process which involves the money market could be conducted but it is postponed.

The other equations of the model (8) to (10) describe the determination of the GDP deflator p (demand deflator p_d) as a

¹² The lines LL and $L'L'$ represent the relative price of the non-traded good the import price at the initial equilibrium A and new equilibrium D respectively.

weighted average of the price index of exports (imports) and the price p_n of the non-traded good. The behaviour of p_n itself in equation (10) reflects the excess demand on the non-traded good market. The parameter ϕ represents the speed at which the non-traded good price will adjust in response to the discrepancy between demand and supply.

The model adopts the case of an open economy and the way equations (8) and (9) are written with the same coefficient for the export price and import price implies that the economy presents a balanced external trade at equilibrium. We note also that the exchange rate will serve as the sole channel of transmission of the monetary policy since for simplicity, the interest rate is omitted in the function of demand for goods (equation 5).

4.2 The solution

The model in continuous time constituted of equations (1) to (10) will bring about the steady state solutions of the non-traded good price and the exchange rate. The analysis will also bear on the dynamics involved. Adding the stochastic elements will come afterwards.

The model can be transformed into a two-equation "reduced form" by substitution of:

- equations (3) to (7) into equation (10) with the use of equations (8) and (9) which define the GDP and demand deflators.
- equation (2) (in which the foreign interest rate i^* is set to zero to simplify) into equation (1).

This gives the following reduced form¹³:

$$\begin{aligned} \left(\frac{dp_n}{E(dS)} \right) &= \begin{pmatrix} -\frac{\phi}{\lambda} \cdot (\alpha \cdot \lambda + (1-\lambda)\eta) & \frac{\phi}{\lambda} \cdot (\alpha \cdot \lambda + (1-\lambda)\eta) \\ \frac{\lambda}{\epsilon} & \frac{(1-\lambda)}{\epsilon} \end{pmatrix} \begin{pmatrix} p_n dt \\ S dt \end{pmatrix} \\ &+ \begin{pmatrix} \frac{\phi}{\lambda} \cdot (1-\lambda)(\lambda+\eta) \\ \frac{\gamma(1-\lambda)}{\epsilon} \end{pmatrix} \cdot p_x^* dt + \begin{pmatrix} 0 \\ -\frac{m dt}{\epsilon} \end{pmatrix} \quad (11) \end{aligned}$$

The price of the non-traded good is chosen as the distinguishing characteristic of the inflation conditions in the domestic economy. But the use of any of the two other price indexes could be considered and should not significantly affect the results.

In a compact form, equations (11) will be rewritten:

$$\left(\frac{dp_n}{E(dS)} \right) = A \begin{pmatrix} p_n dt \\ S dt \end{pmatrix} + B \cdot p_x^* dt + C \cdot m dt \quad (11')$$

where:

$$A = \begin{pmatrix} -\frac{\phi}{\lambda} \cdot (\alpha \cdot \lambda + (1-\lambda)\eta) & \frac{\phi}{\lambda} \cdot (\alpha \cdot \lambda + (1-\lambda)\eta) \\ \frac{\lambda}{\epsilon} & \frac{(1-\lambda)}{\epsilon} \end{pmatrix} \quad (12)$$

$$B = \begin{pmatrix} \frac{\phi}{\lambda} \cdot (1-\lambda)(\lambda+\eta) \\ \frac{\gamma(1-\lambda)}{\epsilon} \end{pmatrix} \quad C = \begin{pmatrix} 0 \\ -\frac{1}{\epsilon} \end{pmatrix} \quad (13)$$

¹³ In the substitutions, we have used the relationship:
 $Y_0 = \lambda Y_n + (1-\lambda)Y_x$ (cf. Blundell-Wignall & Gregory, 1990)

The technique used for the stochastic Dornbusch model as in Miller and Weller (1989) is followed here to deal with the reduced form (11) of the model.

First, the steady state solution is determined by setting $dp_n=0$ and $E(dS)=0$, which gives:

$$p_n^* = (1-\lambda) \left[\frac{(1-\lambda)(\lambda+\eta)}{\alpha\lambda + (1-\lambda)\eta} - \gamma \right] \cdot p_x^{*+m} \quad (14)$$

$$S^* = - \left[\lambda \frac{(1-\lambda)(\lambda+\eta)}{\alpha\lambda + (1-\lambda)\eta} + (1-\lambda)\gamma \right] \cdot p_x^{*+m} \quad (15)$$

Let us denote:

$$K_1 = \frac{\Phi}{\lambda} (\lambda+\eta) (1-\lambda) \quad (16)$$

$$K_2 = \frac{\Phi}{\lambda} (\alpha\lambda + (1-\lambda)\eta) \quad (17)$$

then the solutions (14) and (15) may be rewritten in the form:

$$p_n^* = (1-\lambda) \left(\frac{K_1}{K_2} - \gamma \right) p_x^{*+m} \quad (18)$$

$$S^* = - \left(\lambda \frac{K_1}{K_2} + (1-\lambda)\gamma \right) p_x^{*+m} \quad (19)$$

The equilibrium values of the non-traded good price and the nominal exchange rate depend on the levels of the commodity price

on the world market and the money stock.¹⁴

a. Influence of the money supply

From equations (18) and (19), the steady state price of both the non-traded good and the exchange rate are in a one-for-one relationship with the money stock, meaning an increase in the money stock will translate into an equivalent rise in the domestic price and the exchange rate. The price of the commodity in domestic currency will increase by the same amount. This ensures homogeneity of degree one in m : money is neutral. Indeed such an increase will cause an excess supply on the money market and an excess demand on the goods market. On the latter market the price of the non-traded good will rise consequently to restore equilibrium. Similarly on the money market, the price of the domestic currency will need to fall (depreciation) to restore the initial equilibrium.

Here we can identify the "overshooting" of the exchange rate due to the stickiness of the domestic price. When the money stock increases, the real balances increase immediately and cause a disequilibrium. An instantaneous rise in the demand deflator p_d in equation (1) is required to restore the equilibrium on the asset market. But p_d is defined as a weighted average of the non-traded good price and the nominal exchange rate (after having normalized $p_m^* = 0$). If the former is slow to adjust as assumed in equation (10), then the exchange rate will bear all the burden of the adjustment in the first place with a "spill over" between

¹⁴ One can also determine the production level of the non-traded good at equilibrium:

$$y_n^* = (1 - \lambda - \alpha K_1 / K_2) p_x^*$$

the goods market and the money market. When later on, the price of the non-traded good starts to rise to counter the excess demand and bring back the equilibrium on the goods market, the first increase in the exchange rate will have to be reduced to its long run value: in that sense the exchange rate has overshoot its steady state value. This appears in figure 4.3.

An increase in the money stock shifts the MM curve of the money market equilibrium to $M'M'$. In face of price stickiness, the system goes from A to B by change only in the exchange rate to reach the new equilibrium line of the money market. Then it moves to point C which constitutes the equilibrium point for the economy as a whole. At that point, the exchange rate has risen with respect to point A but it has decreased with respect to B, which means that the exchange rate at point B has overshoot its long run equilibrium position corresponding to point C. The overshooting effect will be measured more precisely later on.

b. Influence of the world commodity price.

The world price will display its effects through multiple channels. The coefficients of p_x^* in equations (18) and (19) indicate the extent to which the world price of the commodity good will affect the steady state values of the non-traded good price and the exchange rate.

To start with, the influence on the domestic price involves two types of effects: direct and indirect effects through the adjustment of the goods market equilibrium. A one unit increase in the world price of the commodity will entail directly an increase in the real income equal to $1-\lambda$. This causes a rise in

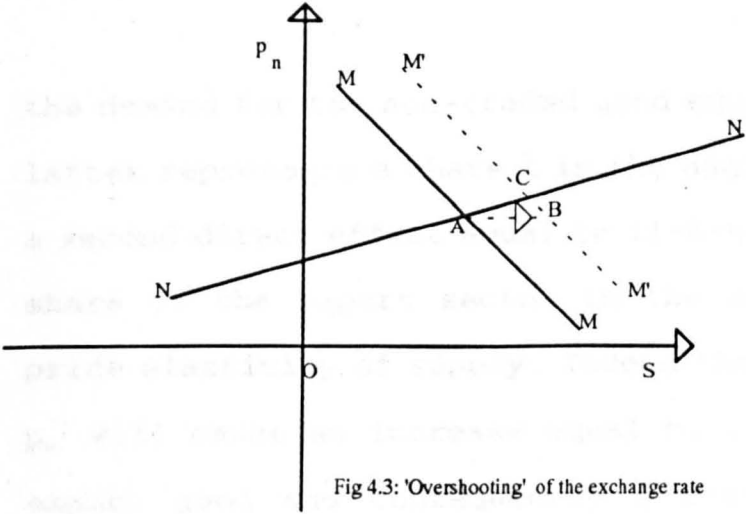


Fig 4.3: 'Overshooting' of the exchange rate

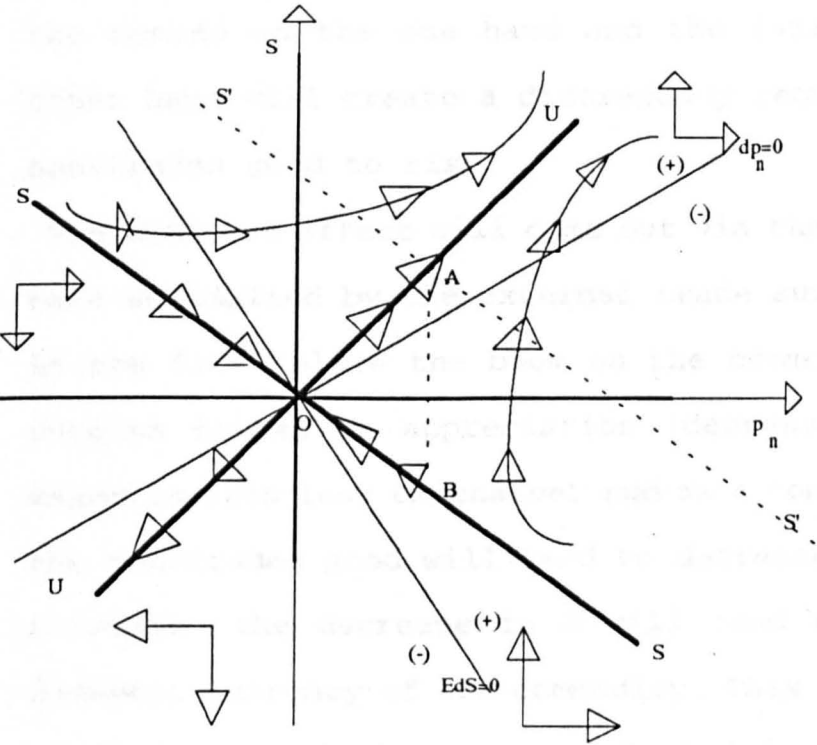


Fig 4.4: Dynamics with overshooting

the demand for the non-traded good equivalent to $\lambda(1-\lambda)$ since the latter represents a share λ in the aggregate demand. There exists a second direct effect equal to $(1-\lambda)\eta$ where $(1-\lambda)$ represents the share of the export sector in the aggregate output and η the price elasticity of supply. Indeed the one unit rise in the price p_x^* will cause an increase equal to $(1-\lambda)\eta$ in the supply of the export good and consequently a corresponding decline in the supply of the non-traded good since the available resources are allocated competitively between the two sectors. The increase in the demand on the one hand and the fall in the supply on the other hand will create a discrepancy requiring the price of the non-traded good to rise.

The indirect effect will come out via the change in the exchange rate as implied by the external trade surplus which accompanies in the first place the boom on the commodity market. The trade surplus causes an appreciation (decrease in S) which in turn makes imports less expensive, and as a consequence the demand for the non-traded good will tend to decrease in the proportion $\lambda\alpha$. Likewise, the decrease in S will tend to reduce the price in domestic currency of the commodity. This gives some incentive to produce more of the non-traded good in the proportion $(1-\lambda)\eta$. These effects via the exchange rate will occur at the second stage and will reduce the excess demand created at the first stage.

The direct effects are measured by K_1 as a numerator in the coefficient of p_x^* (in the expression 18), and the indirect effects which act in the opposite direction to dampen the direct effects are represented by K_2 as a denominator.

The above description concerns mainly the adjustment process on the goods market. What happens on the other market should be considered as well. The effect of the boom on the money market will tend to create an excess demand for money and to reduce inflation. This is captured by the parameter γ in the coefficient of p_x^* . Also the overall impact on the domestic price will depend on the importance of the export sector, which explains the multiplicative term $(1-\lambda)$: in fact the impact on the domestic economy of the boom in the world price can be expressed in terms of $(1-\lambda)p_x^*$ to signify that the commodity price variations on the world market affect the domestic economy through the external sector.

We recall the rather special case mentioned earlier on where the commodity boom provokes a decrease in the domestic price. This corresponds to the situation in which the direct impact as lowered by the indirect effects will prove to be less than the income elasticity of the demand for money:

$$K_1/K_2 < \gamma \quad (20)$$

A high income elasticity combined with a low share $(1-\lambda)$ of the external sector and a high price elasticity of the demand for goods are the conditions likely to establish the special conditions (20).

With regards the determination of S^* in equation (19), the coefficient of p_x^* appears as a weighted average of K_1/K_2 and γ , the respective weights being λ and $(1-\lambda)$.

The description about p_n^* applies similarly to trace the different parameters which appear in the ratio K_1/K_2 . The weighted average identifies the two sources for the appreciation

of the exchange rate following an increase in the commodity price in foreign currency: on the one hand, the combination of direct and indirect effects via the goods demand and supply and on the other hand, the income effect of the demand for money. The weight λ refers to the adjustment on the non-traded good market while the weight $(1-\lambda)$ indicates that the importance of the income effect on the money market will be commensurate to the size of the external sector.

The excess demand for the non-traded good as already presented will cause a rise in p_n and a reduction in the money stock in real terms. Also, the increase in the commodity price results in an soaring of the demand for money. These pressures add to each other to appreciate the currency, hence the coefficient of p_x^* where the relative weights of the two sectors are taken into account. According to equation (19) therefore, an increase in the commodity price leads necessarily to an appreciation of the currency.

c. The real exchange rate ($S-p_n$).

We show in this section that the determination of the real exchange rate at the steady state does not involve monetary variables. So the equilibrium real exchange rate will not depend on the type of exchange regime. Since the present chapter will focus on the comparison between the flexible and fixed exchange rate regimes, the scope of this section will be limited¹⁵.

In the standard model, the PPP relationship by construction rules

¹⁵ More of the analysis on the real exchange rate is given in chapter 6.

out the variations in the real exchange rate. The extended version of this chapter distinguishes a non-tradable and a tradable sectors. The price of the tradable obeys the parity condition while the price of the non-traded good is determined by the condition on the domestic market. The real exchange rate represents the relative price of the two types of goods. Its variations imply a reallocation between the two sectors of the resources available in the economy as mentioned in the earlier discussion on the choice for a criterion.

From the solutions of the domestic price and the exchange rate, we can derive the real exchange rate at the steady state (ERER):

$$\text{ERER} = S^* - p_n^* = -(K_1/K_2)p_x^* \quad (21)$$

This result has been found and tested by BG(1990). It states that in the long run the real exchange rate can be described as depending only on the terms of trade p_x^* : there is no trace of a nominal variable. This corresponds to some extent to the result derived by Edwards (1988a) in which the nominal variables enter only in the short run although other real variables are added besides, such as the Government expenditures or the net capital inflows. Equation (21) simply states that a rise in the commodity price in foreign currency will result in a real appreciation¹⁶.

Table 4.2: Values of K_1/K_2 in %.

¹⁶ In the presentation by Lal (1989) where the model includes explicitly an importable goods sector, to obtain the result that a reduction in the tariff causes a real appreciation would require the additional assumption that the non-traded sector is the most labour-intensive and the importable sector the most capital-intensive one.

$\alpha (= \eta)$				
		0.5	1	1.5
λ				
	0.2	112.5%	93.8%	87.5%
	0.5	100%	75%	66.7%
	0.75	62.5%	44%	37.5%

Table 4.2 gives an illustration of possible values of the coefficient K_1/K_2 in equation (21). For given elasticities, it decreases with the share λ of the non-traded sector, and for given λ , it is higher for economies of low elasticities of demand and supply, and vice-versa¹⁷.

One point we can make here is that in fact one needs not find the solutions S^* and p_n^* at the steady state to derive the equilibrium real exchange rate. The long run real exchange rate may be defined simply and more conventionally as the level which ensures the trade balance.

Let us determine the trade balance (TB) as follows:

$$TB = p_x^* + y_x - (p_m^* + d_m) = y_x - d_m + p_x^* \quad (22)$$

¹⁷ Let us note that to examine the possible values of K_1/K_2 , we have simplified by assuming $\alpha = \eta$. The more general case is considered later.

where the notations are those of the model. Also we have:

$$d = \lambda d_n + (1-\lambda) d_m = \lambda \alpha (S-p_n) + (1-\lambda) d_m + \lambda d \quad (23)$$

$$\Rightarrow d = [\lambda \alpha / (1-\lambda)] (S-p_n) + d_m \quad (24)$$

$$\text{or } d_m = d - [\lambda \alpha / (1-\lambda)] (S-p_n) \quad (25)$$

Combining with the expression which determines the supply of the export good will provide:

$$TB = (\eta + \frac{\lambda \alpha}{1-\lambda}) (S-p_n) + (1+\eta) p_x^* + y - d \quad (26)$$

But from equation (5), we have $y-d = -(1-\lambda)p_x^*$. Therefore:

$$TB = \frac{\lambda \alpha + (1-\lambda)\eta}{1-\lambda} (S-p_n) + (\lambda + \eta) p_x^* \quad (27)$$

The condition of the trade balance $TB = 0$ implies:

$$(S-p_n)^* = - \frac{(1-\lambda)(\lambda + \eta)}{\lambda \alpha + (1-\lambda)\eta} p_x^* \quad (28)$$

that is $ERER = -(K_1/K_2)p_x^*$. The relationship between the equilibrium real exchange rate and the terms of trade can therefore be obtained under the condition of trade equilibrium. It can be shown also that the condition of equilibrium on the non-traded market would lead to the same relationship, due to the fact that the simultaneous equilibrium on both markets is built in the model. A case where this simultaneity does not hold will be seen in chapter 6. In advance, let us say that in general $ERER$

will correspond to the long run equilibrium, that is, the steady state with at least a trade balance and an equilibrium on the market of the non-traded good.

d. Dynamics

To study the dynamics of the model, we refer to the techniques of the saddlepoint analysis. The matrix A of the reduced form has a negative determinant:

$$A = \begin{pmatrix} -\frac{\phi}{\lambda} \cdot (\alpha \cdot \lambda + (1-\lambda) \eta) & \frac{\phi}{\lambda} \cdot (\alpha \cdot \lambda + (1-\lambda) \eta) \\ \frac{\lambda}{\epsilon} & \frac{(1-\lambda)}{\epsilon} \end{pmatrix} \quad (29)$$

$$\text{Det } A = -K_2 \left(\frac{1-\lambda}{\epsilon} + \frac{\lambda}{\epsilon} \right) = -\frac{K_2}{\epsilon} < 0 \quad (30)$$

The reduced form concerns a predetermined variable, namely p_n and a "jump" variable S . This with the result (30) ensures the existence of a saddle-point whose stable manifold corresponds to the negative eigenvalue of A: the system provides a "unique, non-explosive solution for the expected values" of the price level and the exchange rate.

Denoting the negative eigenvalue by r_1 and the corresponding eigenvector by $(1, \theta_1)$, we have by definition:

$$A \begin{pmatrix} 1 \\ \theta_1 \end{pmatrix} = r_1 \begin{pmatrix} 1 \\ \theta_1 \end{pmatrix} \quad (31)$$

The calculations for r_1 and θ_1 are presented in appendix 1a where θ_1 appears to be negative, implying the "overshooting" of the exchange rate in the short run, as in the classic Dornbusch model and as already mentioned.

Along the stable path, the relationship between the nominal exchange rate and the non-traded good price is as follows, omitting the subscript on θ :

$$S - S^* = \theta (p_n - p_n^*) \quad (32)$$

where S^* and p_n^* denote the equilibrium values of the exchange rate and the non-traded good price.

Figure 4.4 gives a phase diagram of the dynamics which are involved. The line $dp_n=0$ and $Eds=0$ describe the paths along which the variable p_n or S takes a constant value. They intersect at the steady state equilibrium, chosen to coincide with the origin.

The stable path and the unstable path are indicated as the lines SS and UU . The direction indicated by the arrows for the stable manifold supports the result of the calculation giving a negative value to the parameter θ or degree of overshooting. If the system departs from a point outside the stable manifold, it would not converge to equilibrium. But the assumption of rational expectations requires at any point in time that the system be located on the stable manifold.

The adjustment with overshooting can receive a further illustration. This can be seen when the equilibrium is disturbed from an initial point like A . With the price stickiness, the

shift goes from A to B to reach the new position of the stable manifold. From B, the system moves along SS to get at point O.

With regards the real exchange rate, the dynamics can be derived from the results already obtained. The overshooting of the real exchange rate will result from the overshooting of the nominal exchange rate with the same reason as before, that is the stickiness of the non-traded good price:

$$RER = S - p_n = S - S^* - (p_n - p_n^*) + S^* - p_n^* \quad (33)$$

Using the relationship along the stable manifold, it follows that:

$$RER = \left(1 - \frac{1}{\theta}\right) (S - S^*) + S^* - p_n^* \quad (34)$$

or equivalently:

$$RER = RER^* + \left(1 - \frac{1}{\theta}\right) (S - S^*) \quad (35)$$

where RER^* denotes the equilibrium real exchange rate. Since the coefficient of the second term on the right hand side of (34) is positive, an overshooting of the nominal exchange rate will cause the same type of overshooting of the real exchange rate. This may constitute a supplementary point of concern about the loss of competitiveness which accompanies a boom in the commodity sector and which is known to take the form of a real exchange rate appreciation.

The movement of the nominal exchange rate along the stable manifold has its counterpart for the real exchange rate. Again

from the dynamics of S and p_n rewritten as follows:

$$E(dS/dt) = [\lambda/(\epsilon\theta) + (1-\lambda)/\epsilon] (S-S^*) \quad (36)$$

$$dp_n/dt = -K_2(1-\theta)(p_n-p_n^*) \quad (37)$$

and taking account of the definition of the θ which ensures the equality of the coefficients of $(S-S^*)$ and $(p_n-p_n^*)$ in (36) and (37) respectively, it will follow that:

$$E(dRER/dt) = K_2(1-\theta)(RER^*-RER) \quad (38)$$

This result constitutes a formal derivation of the formula indicated by BG(1990) to describe the dynamics of the real exchange rate. Equation (38) gives in particular an explicit form of the speed of adjustment as a function of the different parameters of the model. For example and very understandably, the system will, after a disturbance, undergo a faster adjustment process to its equilibrium when the adjustment on the market of the non-traded good is faster (ϕ is higher) or when the supply and demand elasticities are higher (cf appendix 1).

4.3 The economy under shocks: the BG/SD specification.

The analysis above has concerned only the treatment of the economy in which no uncertainty is involved. Now, the velocity-adjusted money stock and the world price of the commodity will be assumed to follow a stochastic process. This constitutes the stochastic Dornbusch model (SD) aspect of the proposed specification. As in the simplified model of chapter 3,

disturbances will face the economy, namely the money shocks and the commodity price shocks. In practice, the different shocks witnessed by a small open economy, in the FZ in particular constitute a larger set. But the two cases considered here will represent most of them. In this respect the terms of trade disturbances may be taken to represent as well the other types of external shocks such as the variations in interest rates or net capital inflows. The effect of real shocks such as crop fluctuations might receive a description along similar lines. S. Black (1976) gives an analysis on this category of domestic production fluctuations although his model differs from the BG model on the determination of the exchange rate.

To start with, we consider the case where the two shocks will behave as random walks¹⁸:

$$dm = \sigma_1 dz_1 \quad (39)$$

$$dp_x^* = \sigma_2 dz_2 \quad (40)$$

where z_1 and z_2 will represent the corresponding Wiener processes and variances σ_1^2 and σ_2^2 the variances. Equations (39) and (40) which describe the behaviour of the stochastic elements add to the set of equations (1)-(10). As this represents the stochastic Dornbusch form of the BG model, we will refer to it as the BG/SD model.

a. Price variability in the free float

¹⁸ The concepts of random walk, diffusion process or Brownian process will be used to mean the same thing to simplify the terminology.

The steady state solutions of the non-traded good price and the exchange rate have been shown to depend on the money stock and the commodity price in foreign currency (equations 18 and 19). In consequence, the steady state equilibrium will move in response to the disturbances facing the economy.

The reduced form equation (11) indicates that we have:

$$dp_n = K_2((S-S^*)-(p_n-p_n^*))dt \quad (41)$$

Since $S-S^* = \theta(p_n-p_n^*)$ along the stable manifold, equation (41) may be rewritten as:

$$dp_n = -K_2(1-\theta)(p_n-p_n^*)dt \quad (42)$$

The difference $p_n-p_n^*$ represents the departure from equilibrium of the domestic (non-traded good) price. We denote

$$\sigma dz = -[\sigma_1 dz_1 + (1-\lambda)(K_1/K_2 - \gamma)\sigma_2 dz_2] \quad (43)$$

Then differentiating $p_n-p_n^*$ gives:

$$d(p_n-p_n^*) = -K_2(1-\theta)(p_n-p_n^*)dt + \sigma dz \quad (44)$$

Equation (44) describes a Ornstein-Uhlenbeck¹⁹ process whose conditional and unconditional variance are respectively (assuming zero correlation between the two shocks):

$$cVp_n = \sigma_1^2 + \sigma_2^2(1-\lambda)^2\left(\frac{K_1}{K_2} - \gamma\right)^2 \quad (45)$$

¹⁹ This equation may take the form:

$dp_n = -K_2(1-\theta)p_ndt + \sigma dz$ with p_n denoting the departure from equilibrium.

$$uVp_n = \frac{cVp_n}{2K_2(1-\theta)} = \frac{\sigma_1^2 + \sigma_2^2(1-\lambda)^2 \left(\frac{K_1}{K_2} - \gamma \right)^2}{2K_2(1-\theta)} \quad (46)$$

We recall that: $K_2 = (\phi/\lambda)[\alpha\lambda + (1-\lambda)\eta]$.

Consequently the inverse of $2K_2(1-\theta)$ will decrease while K_1/K_2 proves to be independent of ϕ . A relatively high value of ϕ means that the goods market adjusts relatively quickly in response to shocks, which should lead to a lower asymptotic variance of the domestic price.

For the other parameters, a clear-cut interpretation does not seem to be available except for the price elasticity (α) of demand for goods. High values of α will lower both the conditional and the unconditional variances. This is due to the fact that for a given excess demand, a higher price elasticity implies that less change in the domestic price level will be needed to close the gap between demand and supply, every thing else being constant.

b. Flexible versus fixed rate regime.

The calculations above have provided the price variability in the context of the free float. The same type of calculations would need to be done for the fixed rate regime in view of the comparison between the two regimes. But before considering the latter case, let us derive the case of the managed float, of the type examined in the previous chapter, that is a form of commodity standard. From equation (19), it appears that in the free float the exchange rate will appreciate in response to the

commodity price shocks but not enough to insulate the domestic price (i.e. non-traded good price). The managed float will consist of reinforcing the appreciation so as to eliminate the effect of the shock on the domestic price.

We note that the type of regime either a float or a peg would not affect the real exchange rate in the long run although some concern might arise in the short run. What the managed float does however is to bring about a modification of the way an appreciation for example of the real exchange rate is split between the appreciation of the nominal rate and the increase in the domestic price. The need to get the domestic price independent of p_x^* would imply new expressions to hold for the price level and the exchange rate:

$$p_n^{*'} = m \quad (47)$$

and since the equilibrium real exchange rate should not be modified:

$$S^{*'} - p_n^{*'} = -(K_1/K_2)p_x^* \quad (48)$$

where $S^{*'}$ and $p_n^{*'}$ denote the steady state values of the exchange rate and the domestic price corresponding to the managed float regime designed to insulate it from the external shocks. It will follow that:

$$S^{*'} = -(K_1/K_2)p_x^* + m \quad (49)$$

With respect to the free float solution, the managed float will bring about a reinforcement of the appreciation equal to:

$$S^* - S^{*'} = -\lambda(K_1/K_2)p_x^* - (1-\lambda)\gamma p_x + (K_1/K_2)p_x^* \quad (50)$$

$$\Rightarrow S^* - S^{*'} = (1 - \lambda) [(K_1/K_2) - \gamma] p_x^* \quad (51)$$

The term on the right hand side of (51) equals exactly the components of p_n^* related to the terms of trade. This means the transfer from the domestic price to the exchange rate of that part of the adjustment which would mark the domestic price under the free float and which the managed float has shifted on to the exchange rate.

It is assumed that at any time, the managed float succeeds in insulating the domestic price from the external imbalances, which implies that the differential of the domestic price of equation (44) reduces to:

$$dp_n = \sigma_1 dz_1 \quad (52)$$

The corresponding variance is:

$$Vp_n = E(dp_n/dt)^2 \quad (53)$$

$$\Rightarrow cVp_n = \sigma_1^2 \quad (54)$$

Whenever it is feasible, this managed float of leaning with the wind will provide more price stability and would be preferable to the free float regime, comparing the variances in (45) and (54) since it insulates the domestic price from the external shocks. In practice, the degree of management which is required of the float may be less than implied by the model. Indeed, the latter does not include for the sake of simplification the interest rate among the determinants of the demand for goods. In case the interest rate was introduced as an additional channel of transmission for the fluctuations in the terms of trade, then the managed float designed to deal with the boom effect on the

domestic price would decrease the money supply and raise the interest rate. A decrease in demand for the non-traded good would follow, dampening the inflationary pressure.

One may note that the policy of reinforcing the change in the nominal exchange following a boom would not lead to a worsening of the loss in competitiveness when compared with the free float. The real exchange rate proves to be identical under the two types of exchange rate policy. However the decomposition of the real exchange rate into a nominal appreciation and an increase in the domestic price will be modified. The managed float will aim to transfer all of the adjustment on to the exchange rate, to protect the domestic price stability.

Let us now consider the fixed rate regime. The exchange rate is constant and may be normalized to zero. The money supply becomes an endogenous variable. Considering the limits of sterilization, the monetary authorities would not be able to control the money supply because of their intervention on the exchange market to maintain the exchange rate fixed at the same level. Substitutions in the equations of the model in its deterministic form will give:

$$dp_n = -K_2 p_n dt + K_1 p_x^* dt \quad (55)$$

Considering the departure from equilibrium and differentiating it will lead us to the new expression of (56):

$$d(p_n - p_n^{f*}) = -K_2 (p_n - p_n^{f*}) dt - dp_n^{f*} \quad (56)$$

In equation (56), p_n^{f*} represents the equilibrium value of the

domestic price under the fixed regime. It can be shown that the steady state relationship between the domestic price and the terms of trade holds as:

$$p_n^{f*} = (K_1/K_2)p_x^* \quad (57)$$

Using the procedure as in equation (44), the differential equation gives:

$$dp_n = -K_2 p_n dt - (K_1/K_2) \sigma_2 dz_2 \quad (58)$$

Equation (58) shows that under the fixed exchange rate regime, the change in p_n (and equivalently the change in the real exchange rate) does not involve the monetary shocks since these should be accommodated so as to keep the domestic interest rate equal to the foreign interest rate.

This provides the conditional and unconditional variances under the fixed rate regime:

$$cVp_n = (K_1/K_2)^2 \sigma_2^2 \quad (59)$$

$$uVp_n = \frac{K_1^2 \sigma_2^2}{2K_2^3} \quad (60)$$

The comparison between the fixed rate and the flexible or managed float will amount to comparing the corresponding variances of the domestic price. Let us limit the comparison to the case of the fixed rate versus the managed float since the latter is known to deliver more price stability than the free float.

The managed float should be preferred to the fixed rate if the following conditions are satisfied:

- on the basis of the conditional variances:

$$\sigma_1^2 < (K_1/K_2)^2 \sigma_2^2 \quad (61)$$

- on the basis of the unconditional variances:

$$\sigma_1^2 < (K_1^2/2K_2^3) \sigma_2^2 \quad (62)$$

These inequalities are equivalent to:

$$\sigma_1^2/\sigma_2^2 < (K_1/K_2)^2 \quad (63)$$

$$\sigma_1^2/\sigma_2^2 < K_1^2/(2K_2^3) \quad (64)$$

By means of these relationships, we see that the case for or against a float regime (a managed float in particular) in comparison with a fixed rate regime will depend on the relative importance of the two (internal and external) shocks. This result is now a familiar one. The question remains to provide a scale upon which to assess the relative size of the two shocks. Here comes the need to look at the terms on the right hand side of the above conditions. It appears that given the relative importance of the two disturbances, the demand and supply elasticities will matter as well as the share of the export sector in the domestic economy. A formal analysis will use the conditional variances. With regards the unconditional variances, the analysis is more complex. Numerical simulations comparing the float and the fixed rate regimes will be undertaken in the next section to provide an illustration of the way the parameters are involved on the basis of the unconditional variances. The parameter ϕ does not enter expression (63). But on the basis of the unconditional variances, we note that a higher value of ϕ will diminish the chances that the managed float will be preferred. Williamson

(1991) indicates that price flexibility reduces the case for a flexible rate.

c. Context of the FZ countries.

In this subsection, we start the discussion of how the values of the parameters may affect the desirability of adopting the float regime or the fixed rate. The characteristics of the FZ will be taken into account.

To simplify, the conditional variances of the managed float and the fixed rate will be used as a basis of the comparison. The simplification is two-fold. First, we consider the managed float instead of the free float. But further investigations not reported here seem to indicate that the conclusions derived from the analysis of the parameters do not differ when using the conditional variance of the free float or that of the managed float. Secondly, the conditional variance is used instead of the unconditional variance. However the numerical simulation to be undertaken in the next section will involve the unconditional variance.

We rewrite the condition (63):

$$\sigma_1/\sigma_2 < K_1/K_2 \quad (66)$$

Let us denote:

$$R \equiv \frac{K_1}{K_2} = \frac{(1-\lambda)(\lambda+\eta)}{\lambda\alpha+(1-\lambda)\eta} \quad (67)$$

Given the relative size of the money and commodity price shocks, the larger the ratio R the more likely the preference of the float regime will be. The discussion on the significance of the parameters related to the choice of an exchange rate regime will bear therefore on R . It will concern the demand and supply elasticities and the degree of openness.

i) Demand elasticity

The ratio R appears as a decreasing function of the price elasticity of demand for goods (α). Therefore, considering two economies A and B which differ only by their demand elasticity, it will be less costly for A than for B to adopt a fixed rate if A has a higher elasticity. We recall that the parameter α in the ratio represents the effect brought about by the appreciation of the exchange rate following an increase in the commodity price on the world market. This indirect effect is equivalent to a decrease in the demand for the non-traded good and tend to lessen the direct (income) effect which corresponds as we have seen to an increase in the demand. In the case where α takes on a high value, little change in the exchange rate will suffice for the indirect effect to offset the direct effect and prevent an increase in the price level via an excess demand. This would correspond to the characteristics of a developed economy while the FZ economies have a relatively low demand elasticity. The demand for basic food may represent an important component in these countries. The imports also include a significant share of food and capital goods which are not produced locally, making the demand for these goods relatively inelastic.

ii) Supply elasticity

Whether the ratio R is an increasing or decreasing function of the supply elasticity η will depend on the relative value of $(1-\lambda)$ and α . These two parameters represent the direct and indirect effects respectively on the demand side of a change in the commodity price. On the other hand, the parameter η represents the direct effect (in the numerator of R) as well as the indirect effect (in the denominator of R) on the supply side attached in each case with the same weight equal to the share of the export sector. When α is greater than $(1-\lambda)$, the indirect effects (both demand and supply sides) tend to be more important than the direct effects (both demand and supply sides) but this is less and less the case as η increases. Conversely, when α is lower than $(1-\lambda)$ the direct effects tend to be predominant (via the demand channel), and this will be less the case as η increases and tends to re-equilibrate the two types of effects (via the supply channel). In consequence, the ratio R increases as a function of the supply elasticity η when $\alpha > 1-\lambda$ and decreases instead when $\alpha < 1-\lambda$.

The FZ economies are deemed to have relatively low elasticities compared with a large developed country for example. At the same time they are very open economies. The presumption will therefore place emphasis on the second situation of relatively low values of α and high values of $1-\lambda$, to characterize the context of these economies. A higher supply elasticity will diminish the argument for a flexible rate while lower η will increase the favourable argument. The FZ countries may have a low elasticity of export supply, at least for crops like cacao and coffee which are tree-

crops. Some estimates give η between 0.3 and 0.5 in the first year after the price change has been implemented. This value may increase to between 0.5 and 1.5 after three to five years. More specifically, Devarajan & de Melo (1987b) give the following values: $0.2 < \eta < 0.85$ in the manufacturing sector and $0.4 < \eta < 1.7$ in the agriculture sector. The elasticity in the agriculture sector is reported to equal 0.8 for Cameroon, 0.4 for Cote d'Ivoire and 0.4 for Senegal. These characteristics of relatively low elasticities call for a float regime. The exchange rate would provide the necessary extra flexibility these economies need and that they may lack in the production and demand sides.

iii) The degree of openness

As regards the parameter λ which represents the share of the non-traded good with $(1-\lambda)$ representing the share of the export sector or the degree of openness, its link with the ratio is more complex. The investigation of whether high or low values of λ would call in favour of a particular exchange rate regime will lead us to raise a discussion on two criteria widely referred to in the literature on optimal exchange regime, namely the Kenen's criterion that a fixed exchange rate would suit diversified economies while a flexible rate would be called for undiversified economies, and the Mc Kinnon's criterion that open economies should adopt a fixed rate, and closed economies a flexible rate regime. In the present context, an undiversified economy means that σ_2 is relatively great in contrast to diversified economies for which external disturbances tend to "average out" according

to Kenen's argument. At the same time , more diversification corresponds to less openness of the economy. It appears that at this point, Kenen's and McKinnon's criteria seem to conflict with each other as noticed in the literature (Presley & Dennis, 1976). Indeed, according to the latter criterion very open economies are less subject to exchange "illusion" and require a fixed exchange rate regime. In the framework used here, great values of $1-\lambda$ or low values of λ represent a high degree of openness. But the extent to which openness calls for a flexible exchange rate or not will depend on the values of the supply and demand elasticities in the foreign sector as already indicated. More explicit calculations will aim at determining in which cases Kenen's criterion or alternatively McKinnon's criterion will apply.

For this purpose, we note that the differential of R with respect to λ has the same sign as:

$$D = (\eta - \alpha)\lambda^2 - 2\eta\lambda + (1 - \alpha)\eta \quad (68)$$

The analysis of D in function of λ leads us to consider two alternative situations. The first one arises when $1 + \eta - \alpha < 0$. This corresponds to the case when the price elasticity of demand is very high. For $1 + \eta - \alpha < 0$, the analysis shows that D is definitely negative, whatever the values of λ and the same sign applies for the differential of R . In consequence, the ratio R or equivalently the case for float regime will increase when λ decreases , that is when $(1-\lambda)$ i.e the degree of openness increases. In the conditions of high demand elasticity therefore, the Kenen's criterion applies: when openness increases or for that matter, where diversification diminishes, this favours the

float regime. We note that the condition stated above implies that the price elasticity of demand be larger than both unity and the price elasticity of supply.

The second situation arises where $1+\eta-\alpha$ has a positive sign:

$$1+\eta-\alpha > 0 \quad (69)$$

Under the condition (69), a priori four possibilities exist:

case 1:

$$\begin{aligned} 1+\eta-\alpha > 0 \text{ with } \eta-\alpha < 0 \\ \text{and } 1-\alpha < 0 \end{aligned} \quad (70)$$

This case corresponds to an elastic demand for goods, and the demand elasticity is higher than the supply elasticity. It gives the same result and conclusion as the first situation analyzed above, the Kenen's criterion prevailing. The conditions (70) mean that the price elasticity of demand is relatively high with respect to both unity and the supply elasticity although not as high as to be greater than the sum $1+\eta$.

case 2:

$$\begin{aligned} 1+\eta-\alpha > 0 \text{ with } \eta-\alpha < 0 \\ \text{and } 1-\alpha > 0 \end{aligned} \quad (71)$$

Both supply and demand are relatively inelastic. But the latter is less inelastic than the former. Then the results are that the ratio R will increase as a function of λ for values of less than a critical value but it will decrease for λ larger than that critical value. The calculations in appendix 1b give the critical value λ_c :

$$\lambda_c = \frac{\eta - [\eta\alpha(1+\eta-\alpha)]^{\frac{1}{2}}}{\eta-\alpha} \quad (72)$$

$$\Rightarrow 1-\lambda_c = \frac{[\eta\alpha(1+\eta-\alpha)]^{\frac{1}{2}}-\alpha}{\eta-\alpha} \quad (73)$$

This is a case which involves both Kenen's and Mc Kinnon's criteria. For economies with a degree of openness less than $1-\lambda_c$, the first criterion will apply. But the second criterion will hold for a higher degree of openness: the case for a flexible rate diminishes when openness increases from the critical value $1-\lambda_c$ since R decreases. The result corresponds to the argument presented by some part of the literature (cf Ishayama 1975), specifying that in fact the McKinnon's criterion is meant to apply for very open economies.

case 3:

$$1+\eta-\alpha > 0 \text{ with } \eta-\alpha > 0$$

$$\text{and } 1-\alpha < 0 \quad (74)$$

The demand for goods is elastic ($\alpha > 1$) but not as much as the supply. This case leads to the same conclusion as case 1 or the first situation: the Kenen's criterion applies for any value of the parameter λ ($0 \leq \lambda \leq 1$).

case 4:

$$1+\eta-\alpha > 0 \text{ with } \eta-\alpha > 0$$

$$\text{and } 1-\alpha > 0 \quad (75)$$

This is a case where the elasticity of demand happens to be low with respect to unity and with respect to the elasticity of supply. The results and conclusions prove to be identical to those of case 2.

The analysis of the influence that the parameter λ or the degree of openness $1-\lambda$ has on the optimal choice for an exchange rate reduces eventually to the results of cases 1 and 2.

The distinguishing features of the results about the involvement of Kenen's criterion in the different cases seems to be the degree of demand elasticity for both locally produced and imported goods. If the demand is very elastic, in the usual sense that it is higher than one, the Kenen's criterion applies, whatever the value of the other parameter η .

If demand is inelastic, then no matter whether it is more or less inelastic than the supply but provided $1+\eta-\alpha>0$, we need to compare the actual degree of openness to the critical value as given by equation (73) to determine which of the two criteria (Kenen's or McKinnon's) will apply.

Let us note that if there were not the direct and indirect effects related to demand but only the effects related to supply, then the ratio R would reduce to unity whatever the values of λ and η . What happens on the demand side provides therefore the key to explain the link with the degree of openness. The fact that the demand is very elastic ($\alpha>1$) means that the indirect effects have an increasingly offsetting impact vis-a-vis the direct effects, when the exchange rate appreciates or depreciates in response to a change in the commodity price. That response is more important, the larger is the export sector, that is the degree of openness. Having the exchange rate free to vary presents the opportunity of letting the offsetting effect play fully and prevents the upsurge in excess demand.

But for the case of an inelastic demand, the offsetting process

disappears or will operate to a limited extent. In this case, the direct effects on demand reach a very significant level for a very open economy while the indirect effects which are brought by the exchange rate change have relatively little weight. This is the context corresponding to the Mc Kinnon's criterion: the gain obtained from letting the exchange rate appreciate or depreciate gets proportionately lower compared with the direct (income) effect as the importance of the external sector becomes paramount. However, in the case of economies which are not very open, for which the impact of the offsetting process is not yet made relatively too low (that is, not below a critical level) by the relative importance of the external sector and the associated direct effect, the net gain from having a flexible rate will tend to increase so that the Kenen's criterion will apply. This is the sense of the critical level $1-\lambda_c$ defined in equation (73). The value $1-\lambda_c$ provides a measure of openness and the dividing line to consider for deciding which of the above alternative criteria to apply when one is faced with the choice of an appropriate exchange rate regime for an economy characterized by an inelastic demand for goods. A typical application of this approach would relate to the comparison between two countries which have the same size of external and internal shocks and the same demand and supply elasticities but with different degrees of openness. The question of which exchange rate regime will be more suitable will amount to asking whether the actual degree of openness which characterizes each economy is higher or lower than the (common) critical level $1-\lambda_c$.

We have already mentioned the simplifying approach very used in

the literature, that a flexible exchange rate is more appropriate when the economy faces external shocks and conversely a fixed rate regime is to be preferred in face of internal shocks. Then we noted that it is more precise to refer to the relative importance of the two disturbances since in general these are simultaneously present. In the context of the investigation undertaken here, the relative importance is given by the ratio of the two variances of the money disturbances and commodity price disturbances: σ_1^2/σ_2^2 . The argument developed in this section tends to point to an additional other element that needs to be taken into account as an important determinant of the most appropriate regime, and that is primarily the price elasticity of demand.

This has led to an attempt of establishing the link with the other part of the literature which considers the degree of openness as a criterion in favour or against a flexible or fixed exchange rate regime. The degree of openness certainly matters as shown above. But the way it matters depends in turn on the elasticity of demand, and here is where lies the explanation of the so-called conflict between the Kenen's criterion and the Mc Kinnon's criterion. The circumstances under which these criteria hold are clearly identified and distinguished. For economies with elastic demand, the Kenen's criterion applies. Otherwise, that is if demand is inelastic, it will apply only for those categories of economies with low degree openness up to a point (represented by the parameter $1-\lambda_c$ in the context of the present model) while the Mc Kinnon's criterion would apply beyond that point. We recall that openness helps to channel domestic

inflation to neighbouring countries or trading partners in the context of a fixed rate regime. Also, openness makes the exchange rate more effective an instrument to deal with external shocks. Still, there is a third aspect to take into consideration, and that is that openness makes a small economy more sensitive to external shocks. The combination of these three considerations seems to explain why the Kenen's rule tends to predominate and to give a sense of the critical level $(1-\lambda_c)$ determined above about the degree of openness.

The FZ economies may be best characterized as undiversified economies. Their structure also corresponds to a high degree of openness. Furthermore, the characteristics of the FZ economies seem to suggest a low price elasticity of demand. Under these circumstances, the actual share of the export sector compared with the critical level will determine whether to apply the Kenen's or alternatively the McKinnon's criterion.

More importantly, knowing the numerical values of the export sector share, the demand and supply elasticities for a given economy will be enough on the basis of the expression (63) to decide what criterion to apply for the choice of a fixed rate regime or a float exchange rate regime. The following section will give some simulations.

4.4 Numerical illustration.

The discussion in the previous sections have shown that the choice between a flexible exchange rate and a fixed rate regime will depend on the source and size of the disturbances but also on the values of parameters such as the demand and supply

elasticities, the degree of openness and the speed of adjustment on the non-traded good market. Then the search for an optimal exchange rate regime was reduced to the comparison between the managed float and the fixed rate regime on the basis of the variances (conditional or unconditional variances) obtained for the price p_n of the non-traded good. The stochastic saddlepoint Program or Stochastic Sadpoint²⁰ gives among its simulation results the eigen values and eigen vectors of the model and more importantly for our concern it provides the asymptotic or unconditional variances of the endogenous variables. Here we report the variance of p_n , the non-traded good price.

a. The format

Let us rewrite the differential equations of p_n related to the two alternative regimes.

Float regime²¹:

²⁰ This package was developed at the University of Warwick, by Alan Sutherland as a stochastic version of the package "Sadpoint" created in 1982 by Austin and Buiter.

²¹ One may note that the treatment of the free float with the two-element disturbance, using the Sadpoint Program would not raise any particular problem:

$$dp_n = -K_2(1-\theta)p_ndt + \sigma_1 dz_1 + (1-\lambda) \left(\frac{K_1}{K_2} - \gamma \right) \sigma_2 dz_2$$

Indeed, it would suffice to rewrite the equation under the form:

$$dp_n = -K_2(1-\theta)p_ndt + \sigma dz$$

where z represents the composite of z_1 and z_2 with:

$$\sigma^2 = \sigma_1^2 + (1-\lambda)^2 \left(\frac{K_1}{K_2} - \gamma \right)^2 \sigma_2^2$$

assuming zero correlation between the two shocks. But the numerical values of the parameters suggest to simplify by setting

$$dp_n = -K_2(1-\theta)p_n dt + \sigma_1 dz_1 \quad (52)'$$

The corresponding unconditional variance is:

$$uVp_n = \frac{\sigma_1^2}{2K_2(1-\theta)}$$

Fixed rate:

$$dp_n = -K_2 p_n dt + \frac{K_1}{K_2} \sigma_2 dz_2 \quad (58)'$$

$$uVp_n = \frac{K_1^2}{2K^3} \sigma_2^2$$

Under these conditions, the managed float would be preferred to the fixed rate if we have:

$$\frac{\sigma_1^2}{\sigma_2^2} < (1-\theta) \left(\frac{K_1}{K_2} \right)^2 \quad (76)$$

The inequality (76) in terms of the unconditional variances corresponds to (57) which is in terms of the conditional variances. The difference appears as being the multiplicative term $(1-\theta)$ in (76). Because of the fact that the degree of

$$\sigma^2 \approx \sigma_1^2$$

overshooting θ is a complex combination of the other parameters, the comparison using the unconditional variances is best undertaken by means of a numerical simulation as with the Stochastic Sadpoint Program.

The simulation will consider in turn different sets of values of the parameters, starting with a central case which is defined as corresponding to:

$$\lambda=0.6; \alpha=\eta=\phi=\sigma_1=\sigma_2=0.5 \text{ and } \varepsilon=2.$$

Then λ , α and so on will be let to vary in turn.

We need to derive the formats which are appropriate for the Program. In this regard, the model can be rewritten by setting all the exogenous variables to zero and by substitution of the equations defining the GDP and demand deflators into the other equations. This reduces the number of equations to six (6) instead of ten (10), without affecting the nature of the model.

The same can be done with the fixed rate regime. In addition, one normalizes the fixed exchange rate to zero. This deletes the currency arbitrage equation. But we recall that in this fixed rate regime, the money stock becomes an endogenous variable in the equation defining the money market equilibrium.

In both cases, the disturbance is added as a supply shock. The semi-reduced model becomes:

Flexible rate:

$$\lambda p_n = \varepsilon i \quad (a1)$$

$$E(ds) = idt \quad (a2)$$

$$y_x = \eta(S-p_n) \quad (a3)$$

$$\lambda y_n + (1-\lambda)y_x = 0 \quad (a4)$$

$$d_n = \alpha(S-p_n) \quad (a5)$$

Input data format (fixed rate regime)

	p_n	dp_n	m	y_x	y_n	d_n	dz_2
dp_n	0	1	0	0	ϕ	$-\phi$	$-K_1 \backslash K_2 \cdot \sigma_2$
m	$-\lambda$	0	1	0	0	0	0
y_x	η	0	0	1	0	0	0
y_n	0	0	0	$1-\lambda$	λ	0	0
d_n	α	0	0	0	0	1	0

The formats of Stochastic Sadpoint , and the above formats in particular, are very similar to those of the deterministic version Sadpoint. The difference relates to the introduction of the stochastic elements: these are inserted in the formats at the place of the exogenous variables.

b. The results

The tables (T_λ to T_ϕ) below give the results of the simulations. In table T_λ , λ varies while the other parameters equal the central case values. The same procedure applies for T_α , T_η and so on. Each parameter is given three different values when it varies.

Note that the second column of table T_λ corresponds to the results of the central case λ_0 , that is the case where $\lambda=0.6$ and $\alpha=\eta=\phi=\sigma_1=\sigma_2=0.5$ and $\varepsilon=2$.

Asymptotic variance of p_n in the tables below:

Table T_λ

	$\lambda=0.3$	$\lambda=0.6$	$\lambda=0.8$
Flexible rate	0.12979	0.20204	0.2029
Fixed rate	0.18816	0.23223	0.10816

Table T_α

	$\alpha=0.2$	$\alpha=0.8$	$\alpha=1.2$
Flexible rate	0.28025	0.15952	0.12534
Fixed rate	0.88623	0.09234	0.03728

Table T_η

	$\eta=0.2$	$\eta=0.8$	$\eta=1.2$
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Flexible	0.2476	0.17142	0.14314
rate			
Fixed	0.27999	0.19736	0.16383
rate			

Table T_{σ_2}

	$\sigma_2=0.2$	$\sigma_2=1$	$\sigma_2=1.5$
Flexible	0.20204	0.20204	0.20204
rate			
Fixed	0.03717	0.92928	2.09088
rate			

Table T_ϵ

	$\epsilon=1$	$\epsilon=1.5$	$\epsilon=3$
Flexible	0.16667	0.18750	0.22150
rate			

Fixed	0.23232	0.23232	0.23232
rate			

Table T_ϕ

	$\phi=0.2$	$\phi=0.8$	$\phi=1.2$
Flexible	0.38824	0.14028	0.10067
rate			
Fixed	0.58080	0.14520	0.09680
rate			

c. Observations

A number of comments follow after an examination of the simulation results:

(i) the choice between the two exchange rate regimes does not seem to be affected very much by some of the parameters, that is whether they are low or high. This is the case of the supply elasticity η and the semi-elasticity ε of the demand for money with respect to the interest rate. Indeed in tables T_η and T_ε , the price variance is lower in the float regime than in the fixed rate regime under the different values considered of η and ε . We may even indicate that the same result holds for table T_ϕ but only for relatively low values of ϕ ($\phi \leq 0.8$). For higher values

of the speed of price adjustment ϕ , the choice might be reversed in favour of the fixed rate, thus to indicate that price flexibility reduces the case for a flexible exchange rate regime.

(ii) the relative merit of the exchange rate regime changes as the parameter increases in tables T_λ , T_α and T_{σ^2} . Table T_α and the central case show that the managed float is to be preferred for the range of relatively low values of α (up to $\alpha=0.5$) while the fixed rate performs better for $\alpha = 0.8$ or greater values. This result is compatible with the points of the previous discussion about the simplified ratio $R \equiv K_1/K_2$.

In table T_λ , the float regime outperforms the fixed rate regime except for high values of λ , that is a low degree of openness. This supports the Kenen's argument according to which less and less diversification (i.e more openness) calls in favour of a float regime. To compare with the discussion on the two Kenen's and Mc Kinnon's criteria, let us denote λ_c the critical value of λ when the other parameters take on their values as in table T_λ , (that is their levels in the central case). At the same time, we have $1+\eta-\alpha > 0$ and $1-\alpha > 0$, which corresponds to the case 2 of the review and discussion earlier on about the degree of the openness. On the basis of the formula²² (72), it equals:

$$\lambda_c = 0.25$$

This value is less than the values of λ in table T_λ , implying that the Kenen's criterion should apply. The result is again compatible with this criterion derived from the use of the ratio R . But the analysis of R cautions us about another possibility,

²² When $\eta-\alpha=0$, the formula (64) can not be used but some calculations indicate that its equivalent is: $\lambda_c=(1-\alpha)/2$.

if λ_c was higher than the value $\lambda=0.3$ or $\lambda=.6$ for example of table T_λ . More on this point will follow in (iv) below.

Table T_α gives an illustration of the influence that the price elasticity of demand has on the choice for the optimal regime: the case for a fixed rate regime increases significantly when α rises. Starting with a value of $\alpha=0.2$, one can see that the price variability is lower in the float than in the fixed rate regime in the very significant proportion of around 1 to 4 at that level of α . But the result of a preference for the float is hardly maintained when α rises to $\alpha=0.5$ and gets reversed for $\alpha=0.8$.

With regards table T_{σ_2} , it simply relates to the relative size of the two shocks. When they have the same size or when the external shocks are more important than the money shocks, then the managed float should be preferred to the alternative regime of a fixed rate. The choice should be reversed however when the money disturbances are significantly more important than the commodity price disturbances: the ratio of the two variances of p_n under the two regimes changes as the ratio of the two shock variances, illustrating the direct influence that the size of these shocks have on the degree of price variability.

(iii) we note that the variances in tables T_α and T_η decrease as α or η increases: higher demand and supply elasticities lead to lower price variability. This illustrates a point made earlier on comparing economies with high price elasticity and the others. By contrast, the variance of p_n obviously increases with σ_2 in the fixed rate regime. The same pattern should apply for the float regime with σ_1 increasing. More importantly, the price variability seems to be very sensitive to the size of the shocks

compared with the other parameters. An exception if any would be the parameter α (demand elasticity): table T_α shows that the variance of p_n decreases very quickly when α increases, particularly in the fixed rate regime.

(iv) to investigate possibilities involving the Mc Kinnon's criterion, particular values of α and η have been chosen to compute the following values of λ_c (represented below as λ_{ci} , $i=1$ to 3) as well as the corresponding tables $T_{\lambda_{ci}}$ which can be compared with the central case T_λ . We may recall that the case of table T_λ corresponds to the Kenen's criterion $\lambda > \lambda_c$.

The tables $T_{\lambda_{ci}}$ ($i=1$ to 3) have been constructed so that to illustrate the case which involves the two criteria. The parameters have been chosen in such a way that the following situations are covered:

- all the three values of λ are lower than the critical value λ_c (table $T_{\lambda_{c1}}$)
- the second value of λ coincides with the critical value λ_c , the other values of λ being lower and higher respectively than λ_c (table $T_{\lambda_{c2}}$)
- all the three values of λ are higher than the critical value λ_c (table $T_{\lambda_{c3}}$).

The values of the other parameters equal the values chosen for the central case ($\phi=\sigma_1=\sigma_2=0.5$; $\varepsilon=2$).

Table T_{λ_1} typically represents the situation where the Mc Kinnon's criterion will apply. The variance of p_n in the flexible regime decrease relative to the variance of p_n in the fixed regime as λ increases. That is to say that the fixed rate regime will tend to be preferred as the degree of openness $(1-\lambda)$

increases. This is consistent with the previous discussion since λ is lower than λ_c . By contrast, the Kenen's criterion will apply in a situation corresponding to the characteristics contained in table $T_{\lambda c3}$ which uses a much higher value of the price elasticity of demand α than table $T_{\lambda c1}$. The ratio of the variances of p_n in the flexible and fixed regimes increases with λ , which means that the flexible rate will tend to be preferred as the degree of openness increases. The values of λ are higher than the critical value $\lambda_c = 0.101$.

The table $T_{\lambda c2}$ gives the intermediate case where the ratio between the two variances of p_n in the flexible rate regime and the fixed rate regime decreases for the values of λ between $\lambda=0.3$ and $\lambda=0.5$, and it increases for λ between $\lambda=0.5$ and $\lambda=0.8$. This case corresponds to a value of α equal 0.2 and illustrates the possibility of reversing the optimal rule for the exchange rate policy as the degree of openness or equivalently the level of non-diversification compares with the value $1-\lambda_c=0.5$.

If the country in question starts with as a sufficiently open economy, then the case for the flexible rate will tend to diminish as openness augments whereas it will increase with openness if the starting point is marked by a relatively low degree of openness. This result of the numerical simulation again confirms the result obtained above that the Mc Kinnon criterion might be used only for very open economies.

If we were to undertake an attempt at a generalization on the basis of the results just discussed, it would follow in simple terms. An economy with a price-elastic demand for goods should refer to the Kenen's criterion. It should favour a flexible rate

regime as its openness increases. The Kenen's criterion appears much as a general rule. The conditions under which the McKinnon's criterion will apply are more restricted: a very low price elasticity of demand of goods combined with a high degree of openness. It appears therefore that the parameters λ and α are the most determinant with regards the optimal exchange rate rule. The Kenen's criterion as a general rule might receive a possible interpretation. An economy with high price elasticity can cope with the external shocks for a given relative size of the shocks (σ_2^2/σ_1^2), without resorting to the exchange rate as an instrument provided the external sector has a limited size. But as the external sector becomes larger, the price elasticity does not suffice any longer and the need for the use of the exchange rate policy as an element of flexibility becomes more and more apparent.

Table $T_{\lambda c1}$ $\alpha=0.02$ $\eta=1$ $\lambda_{c1}=0.817$

	$\lambda=0.3$	$\lambda=0.5$	$\lambda=0.8$
Flexible rate	0.09533	0.2337	0.40390
Fixed rate	0.17649	0.87854	2.57200

Table $T_{\lambda c2}$ $\alpha=0.2$ $\eta=1$ $\lambda_{c2}=0.5$

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	$\lambda=0.3$	$\lambda=0.5$	$\lambda=0.8$
Flexible	0.08915	0.15825	0.28875
rate			
Fixed	0.14148	0.32552	0.55556
rate			

Table $T_{\lambda_{c3}}$ $\alpha=0.8$ $\eta=1$ $\lambda_{c3}=0.101$

	$\lambda=0.3$	$\lambda=0.6$	$\lambda=0.8$
Flexible	0.07333	0.12994	0.15810
rate			
Fixed	0.07477	0.09016	0.04373
rate			

4.5 The commodity price as a Poisson process in the BG/SD model.

The interest of the Poisson process specification as a description of the commodity price behaviour has been illustrated in the simplified model. It helps to highlight the role of anticipations on the determination of the exchange rate and consequently on a number of macroeconomic variables including the

domestic price variability. Taking account of the anticipations of the economic agents by means of the Poisson process goes some way in an effort to better capture their typical behaviour of rationality in a context of uncertainty.

Now we attempt at a generalization by introducing the Poisson process in the more complex model of the present chapter. This will involve two steps. The first one relates to calculations for the determination of the steady state solutions. The second step will be about the comparison between exchange rate regimes.

a. Presentation and derivation.

In what follows, the form of the stochastic process remains unchanged for the money variable. But the export price will be assumed to behave as a point process. In fact, the export price is taken to be identical to the commodity price and to behave as a Poisson process. This assumption seems to suit the case of a commodity-exporting economy where the export sector is largely dominated by one or a few commodities. Actually, the commodity sector in the FZ economies had experienced a series of booms and busts on several commodity markets during the last two decades.

Let us assume that the nominal exchange rate and the price in the non-traded sector are function of m and p_x^* which are the fundamentals and which will determine the equilibrium point.

$$p_n = p_n(m, p_x^*)$$

$$S = S(m, p_x^*)$$

Applying the rule of stochastic differential to p_n for example leads to:

$$dp_n = \frac{\partial p_n}{\partial m} \sigma_1 dz_1 + \frac{1}{2} \frac{\partial^2 p_n}{\partial m^2} \sigma_1^2 dt + [p_n(m, p_x^* + p_H^* - p_L^*) - p_n(m, p_x^*)] dp_x^* \quad (77)$$

where dp_x^* represents the Poisson distribution and π_{LH} is the probability that the size of the jump be $p_H^* - p_L^*$ when the "event" occurs (i.e. change in the state variable p_x^*).

As in the previous sections when dealing with the Poisson process, the commodity price is assumed to take on two values only: the low level p_L^* and the high level p_H^* . The process consists of jumping from one level to the other. But the jumps are assumed not to occur very often, to fit the Poisson distribution characteristics.

If the system rests at the position L corresponding to: $p_x^* = p_L^*$, the expected value of equation (77) is:

$$\frac{E(dp_n)}{dt} = \frac{1}{2} \frac{\partial^2 p_n}{\partial m^2} \sigma_1^2 + \pi_{LH} [p_n(m, p_H^*) - p_n(m, p_L^*)] \quad (78)$$

Again, the context of a free float will imply that $\partial^2 p / \partial m^2 = 0$.

At this stage, we need to determine the solutions $p_n(m, p_H^*)$ and $p_n(m, p_L^*)$

Referring back to equation (11), the condition of steady state equilibrium for the domestic price in this case of a Poisson process appears at position L^{23} as:

$$\pi_{LH} (p_{nH} - p_{nL}) = -K_2 (p_{nL} - p_{nL}^*) + K_2 (S_L - S_L^*) \quad (79)$$

²³ The values K_1 and K_2 used in this section are those defined previously in equations (16) and (17).

where p_{nL}^* and S_H^* correspond to the equilibrium values in the Brownian case and p_{nL} and p_{nH} correspond to the values of p_n at positions Low (L) and High (H) of the commodity price respectively in the Poisson process context, and $A_L = K_1 p_L^*$.

We will consider first the solutions of the float regime first. Taking account of the relationships between the exchange rate and the domestic price on the stable manifold:

$$S_L - S_L^* = \theta (p_{nL} - p_{nL}^*)$$

one may rewrite equation (79) as follows:

$$\pi_{LH} (p_{nH} - p_{nL}) = -K_2 (1 - \theta) (p_{nL} - p_{nL}^*) \quad (81)$$

or equivalently:

$$(-\pi_{LH} + K_2 (1 - \theta)) p_{nL} + \pi_{LH} p_{nH} = K_2 (1 - \theta) p_{nL}^* \quad (82)$$

Similarly at position H, we have:

$$\pi_{HL} p_{nL} + (-\pi_{HL} + K_2 (1 - \theta)) p_{nH} = K_2 (1 - \theta) p_{nH}^* \quad (83)$$

Solving the system (82) and (83) brings about the solutions:

$$p_{nL}^{**} = \frac{(K_2 (1 - \theta) - \pi_{HL}) p_{nL}^* - \pi_{LH} p_{nH}^*}{K_2 (1 - \theta) - \pi_{LH} - \pi_{HL}} \quad (84)$$

$$p_{nH}^{**} = \frac{-\pi_{HL} p_{nL}^* + (K_2 (1 - \theta) - \pi_{HL}) p_{nH}^*}{K_2 (1 - \theta) - \pi_{LH} - \pi_{HL}} \quad (85)$$

The double star solution correspond to the solution of the Poisson process under the flexible regime and the one star notation to the solutions of the Brownian motion process under the same flexible regime. Since the parameter θ takes on negative values and that the transition probabilities are generally small,

the denominator of the expressions should be positive. This leads to the configuration in fig 4.5. It corresponds to the normal result already found in the previous chapter: the introduction of expectations gives higher levels of the domestic price at position H ($p_{nH}^{**} > p_{nH}^*$) and lower levels at position L

($p_{nL}^{**} < p_{nL}^*$) because of the smoothing effect that the expectations have on the exchange rate. The distance of the domestic price at positions H and L respectively will appear as:

$$p_{nH}^{**} - p_{nL}^{**} = \frac{K_2(1-\theta)(p_{nH}^* - p_{nL}^*)}{K_2(1-\theta) - \pi_{LH} - \pi_{HL}} \geq p_{nH}^* - p_{nL}^* \quad (86)$$

The expectations will cause the domestic price to vary to a larger extent than it would otherwise do. This confirms the results of the simplified model which led to the idea of a managed float to offset this extra inflation effect due to the lesser variations of the exchange rate.

b. Price variability and exchange rate regime

As before the variance of the non-traded good price will serve as a measure for the price variability. Considering the flexible exchange rate regime to start with, let us assume that the system starts from the equilibrium where the fundamentals p_x^* and m are equal to zero. From that point, a change dp_x^* in the commodity price will cause a shift in the equilibrium value p_n^{**} , which gives:

$$dp_{n_t} = -K_2(1-\theta)p_n dt - [\sigma_1 dz_1 + \pi_{LH}(p_{nH}^{**} - p_{nL}^{**}) d\phi_{x_t}] \quad (86)$$

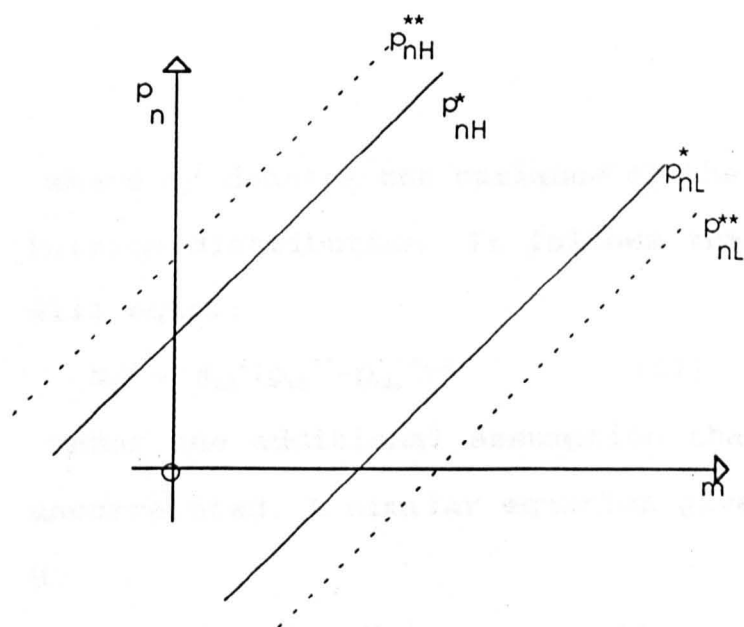


Fig 4.5 The domestic price under the Poisson process disturbances.

where σ_1^2 denotes the variance of the monetary shocks and ρ_x the Poisson distribution. It follows that the conditional variance will equal:

$$\sigma_1^2 + \pi_{LH}^2 (p_{nH}^{**} - p_{nL}^{**})^2 \quad (87)$$

under the additional assumption that the two disturbances are uncorrelated. A similar equation gives the variance at position H:

$$\sigma_1^2 + \pi_{HL}^2 (p_{nH}^{**} - p_{nL}^{**})^2 \quad (88)$$

The unconditional variances (ucV) will then take the form:

$$ucV = \frac{cVp_n}{2K_2(1-\theta)}$$

The following values serve to compute the variances by substitution in the above equations:

$$p_{nH}^{**} - p_{nL}^{**} = \frac{K_2(1-\theta)(p_{nH}^* - p_{nL}^*)}{K_2(1-\theta) - \pi_{LH} - \pi_{HL}} \quad (86)'$$

and

$$p_{nH}^* - p_{nL}^* = (1-\lambda) \left(\frac{K_1}{K_2} - \gamma \right) (p_H^* - p_L^*) \quad (89)$$

Now let us consider the alternative exchange rate, the fixed exchange rate. Under this regime, one may normalize to zero the nominal exchange rate and write the change in the domestic price as equal:

$$dp_n = -K_2 p_n dt + K_1 p_x^* dt \quad (90)$$

With the Poisson process specification, the expected value of

(90) takes the form:

$$\pi_{LH}(p_{nH}-p_{nL}) = -K_2 p_{nL} + K_1 p_L^* \quad (91)$$

$$\pi_{HL}(p_{nL}-p_{nH}) = -K_2 p_{nH} + K_1 p_H^* \quad (92)$$

Solving this set of equations brings about:

$$p_{nL}^{f**} = \frac{K_1}{K_2} \frac{(K_2 - \pi_{HL}) p_L^* - \pi_{LH} p_H^*}{K_2 - \pi_{LH} - \pi_{HL}} \quad (93)$$

$$p_{nH}^{f**} = \frac{K_1}{K_2} \frac{(K_2 - \pi_{LH}) p_H^* - \pi_{HL} p_L^*}{K_2 - \pi_{LH} - \pi_{HL}} \quad (94)$$

The notations p_{nH}^{f**} and p_{nL}^{f**} represent the solutions of the Poisson process model under the fixed exchange rate regime to compare with p_{nL}^{f*} and p_{nH}^{f*} solutions of the Brownian motion process under the same fixed exchange rate regime.

Again as for the float, the distance $p_{nH}^{f**} - p_{nL}^{f**}$ is higher than under the Brownian motion case:

$$p_{nH}^{f**} - p_{nL}^{f**} = \frac{K_1}{K_2 - \pi_{LH} - \pi_{HL}} (p_H^* - p_L^*) \geq \frac{K_1}{K_2} (p_H^* - p_L^*) = p_{nH}^{f*} - p_{nL}^{f*} \quad (95)$$

This time though, the source should be sought in the effect of expectations on the money stock instead of nominal exchange rate. The model shows that the demand for money depends on the real income and consequently on the level of the commodity price. The effect of expectations will be reflected in the real income. At position L, the agents believe that their income will increase

in the next period. This tends to increase the demand for real balances and to depress the price level. Conversely at position H, expectations of lower income in the next period will reduce the demand for money and result in a higher level of the domestic price than it would normally do.

The conditional and unconditional variances can be obtained by following the same procedure as above:

$$cVP_n = \frac{K_1^2 \pi_{LH}}{(K_2 - \pi_{LH} - \pi_{HL})^2} (p_H^* - p_L^*)^2 \quad (95)$$

$$ucVP_n = \frac{K_1^2 \pi_{LH}}{2K_2 (K_2 - \pi_{LH} - \pi_{HL})^2} (p_H^* - p_L^*)^2 \quad (96)$$

The comparison between the two exchange rate regimes can be undertaken on the basis of the domestic price variance. The flexible rate will be preferred to the fixed rate provided the former displays a lower variance of the domestic price. In terms of the conditional and unconditional variances respectively, this takes the form:

$$\sigma_1^2 + g^2 \left(\frac{K_2 (1 - \theta)}{K_2 (1 - \theta) - \pi_{LH} - \pi_{HL}} \right)^2 \pi_{LH} (p_H^* - p_L^*)^2 < \frac{K_1^2 \pi_{LH}}{(K_2 - \pi_{LH} - \pi_{HL})^2} (p_H^* - p_L^*)^2 \quad (97)$$

$$\frac{1}{1 - \theta} [\sigma_1^2 + g^2 \left(\frac{K_2 (1 - \theta)}{K_2 (1 - \theta) - \pi_{LH} - \pi_{HL}} \right)^2 \pi_{LH} (p_H^* - p_L^*)^2] < \frac{K_1^2 \pi_{LH}}{(K_2 - \pi_{LH} - \pi_{HL})^2} (p_H^* - p_L^*)^2 \quad (98)$$

If we assume for example that a managed float can succeed in insulating the domestic price from external shocks, then expression (97) for example will be reduced to:

$$\sigma_1^2 < \frac{K_1^2 \pi_{LH}}{(K_2 - \pi_{LH} - \pi_{HL})^2} (p_H^* - p_L^*)^2 \quad (97)'$$

We can see the implications of introducing the Poisson process compared with the Brownian motion process where the expression was:

$$\sigma_1^2 < \frac{K_1^2}{K_2^2} \sigma_2^2 \quad (61)'$$

with σ_2^2 denoting the variance of the commodity price. The term corresponding to σ_2^2 in the case of a Poisson process is $\pi_{LH}(p_H^* - p_L^*)^2$. Again, the managed float offsets completely the effects of expectations, which represents an advantage with respect to the fixed rate regime because the Poisson process involves expectations not offset under the fixed exchange rate regime and which increase the variance of the domestic price compared with the Brownian motion process.

It follows that an optimal policy would require from a given small open economy to favour a flexible exchange rate more when it faces shocks which follow a Poisson process than when the disturbances alternatively follow a Brownian motion process,

everything else being equal, particularly if the float (assumed here to be a managed float) can eliminate any influence of the commodity price fluctuations on the domestic price index. But it might be possible for the Government to offset the effects of expectations under the fixed rate regime so that the variance of the domestic price with the Poisson process be the same as with the Brownian process. Such a case may arise through the functioning of a Stabilization Fund whereby the fluctuations in the commodity price are not passed on to the representative consumer (cf. chapter 5).

c. Domestic price protection.

In the BG/SD model there will be the case of two degrees or types of managed float. The first type is similar to the one described in the previous chapter. It will result from the presence of anticipations as implied by the introduction of a Poisson process to represent the behaviour of the commodity price. This managed float related to the Poisson process will consist of eliminating the smoothing effect which originates from the anticipations by reinforcing the appreciation or the depreciation of the exchange rate. When the managed float is limited to this case, it will be referred to as a moderate managed float, type P (MMF_p).

The second type or degree of managed float will result from the fact that even without anticipations, the equilibrium domestic price depends on the commodity price in foreign currency. This means that the exchange rate does not respond to the external disturbances sufficiently to offset their effect on the other

variables of the economy: a part of the adjustment is borne by the domestic price whereas in the simplified model the response of the exchange rate was enough to insulate the economy from the external shocks, at least in the absence of anticipations. This second case will be referred to as the moderate managed float type B (MMF_B). If the managed float encompasses the two degrees of managed float MMF_B and MMF_P , then that would be the full managed float (FMF). But the latter case is not covered here. In what follows, we look at the MMF_B type first which will enable us to compare with the results of BG (1990).

(i) The degree of management: the Brownian motion case

The condition for a full response of the exchange rate and an insulation of p_n in the absence of anticipations can be seen from equations (18) and (19) which give the relationships of the equilibrium values p_n^* and S^* with respect to p_x^* and m in the context of a float. Considering the standard case where the income elasticity of the demand for money equals unity, the relative importance of the direct and indirect effects of an increase in the commodity price will determine the degree of response by the exchange rate. The domestic price will be protected if the direct effect via the supply and demand channels (directly related to the increase in p_x^*) are balanced by the indirect effects (via the supply and the demand channels) that the appreciation of the exchange rate brings about. In the simplified model, the comparison was between the increase in the commodity price or terms of trade p_x^* and the appreciation of the exchange rate S . Here the change in the exchange rate takes the

form of the direct effects scaled by the indirect effects (ratio between the two types of effects). If the former exactly equal the latter, then the appreciation of the exchange will reflect on a one-for-one basis the jump in the commodity price. This will depend solely on the equality or non-equality between the direct and indirect effects on the demand side, that is, on the share of the external sector which represents the direct (demand) effects, compared with the price elasticity of demand which represents the indirect effects. The type of managed float implied here will require amplifying the indirect effects so that they equal the direct effects. The reverse would apply if the direct effects were less than the indirect effects.

Managing the float to protect the domestic price amounts to reinforcing the changes in the exchange rate. The size of the reinforcing action will be a determinant factor of the exchange rate rule. The calculations below aim at deriving a measure of that factor in the case where the commodity price follows a Brownian motion process.

The monetary rule to insulate the domestic price takes the form:

$$m = m_0 - v p_x^* \quad (99)$$

where m represents the actual level of the money supply and m_0 the exogenous component of the money supply which would prevail if there was not the active involvement of the monetary authorities. The parameter v denotes the degree of intervention. The monetary authorities seek to protect the domestic price from the external shocks. They choose to use the exchange rate as a mean of achieving this aim, and that is the sense of equation (99) under a regime of exchange rate float.

Replacing m by its value in the money market equilibrium equation of the model set up at the beginning of the present chapter would give:

$$m_0 - p_d - v p_x^* = \gamma(y + p - p_d) - \varepsilon i \quad (1)'$$

The steady state solutions that we obtain with the modified money market equation and the other equations (2) to (10) of the model and that one may denote $p_{n,MFB}^*$ and S_{MFB}^* respectively for the domestic price and the exchange rate can be shown to be:

$$p_{n,MFB}^* = [(1-\lambda) \frac{K_1}{K_2} - [(1-\lambda)\gamma + v]] p_x^* + m_0 \quad (100)$$

$$S_{MFB}^* = -[\lambda \frac{K_1}{K_2} + (1-\lambda)\gamma + v] p_x^* + m_0 \quad (101)$$

Equations (100) and (101) provide a more precise basis for the discussion raised by BG (1990) about the conditions under which the managed float would be a policy of leaning against or with the wind. According to equation (101), a positive value of v corresponds to the second type of policy while a negative value would correspond to the first one. We obtain the value v_0 of v which achieves the complete protection of the domestic price from the external disturbances by setting to zero the coefficient of p_x^* in equation (100):

$$(1-\lambda) [\frac{K_1}{K_2} - (1-\lambda)\gamma - v] = 0 \quad (102)$$

$$\Rightarrow v_0 = (1-\lambda) \left(\frac{K_1}{K_2} - \gamma \right) \quad (103)$$

This result gives further light on the discussion by BG (1990) about the issue of whether to adopt a policy of leaning with or against the wind. The value of v_0 is positive (leaning with the wind) if $K_1/K_2 - \gamma > 0$ that is when the characteristics of the economy (see discussion above on this point) are such that an increase in the commodity price provokes an increase in the price level. One may agree quite easily that those circumstances call for a policy which consists of reinforcing the appreciation of the exchange rate, as far as the concern of the monetary authorities focuses on price stability.

Conversely, the monetary rule should be a policy of leaning against the wind ($v_0 < 0$ or equivalently $K_1/K_2 - \gamma < 0$) when an increase in the commodity price causes a decrease in the domestic price level, if again the primary concern is to maintain price stability.

(ii) The Poisson process case

This is to determine the degree of management in the case of a MMF float type P. We know that the anticipations implied by the commodity price behaviour when it follows a Poisson process lead to more variation in the domestic price. The MMF_p float will aim at keeping p_n at the level it would take in the absence of such anticipations, that is in the Brownian motion case. The monetary rule is written as before:

$$m = m_0 - v p_x^*$$

We denote the equilibrium values of p_n at positions L and H by p_{nLm}^{**} and p_{nHm}^{**} respectively when the managed float is in operation. Given the form of equation (84) and (85), and the way the parameter v enters the solutions in the Brownian motion case, it follows:

$$p_{nLm}^{**} = p_{nL}^{**} + \frac{\pi_{LH} v_H p_H^* - (K_2(1-\theta) - \pi_{HL}) v_L p_L^*}{K_2(1-\theta) - \pi_{LH} - \pi_{HL}} \quad (104)$$

$$p_{nHm}^{**} = p_{nH}^{**} + \frac{\pi_{HL} v_L p_L^* - (K_2(1-\theta) - \pi_{LH}) v_H p_H^*}{K_2(1-\theta) - \pi_{HL} - \pi_{LH}} \quad (105)$$

where v_L and v_H denote the values of the degree of management at positions L and H respectively. The managed float MMF_p will ensure the equality:

$$p_{nLm}^{**} = p_{nL}^* \text{ and } p_{nHm}^{**} = p_{nH}^* \quad (106)$$

Replacing in (104) and (105) will give:

$$-[K_2(1-\theta) - \pi_{HL}] p_L^* v_L + \pi_{LH} p_H^* v_H = (p_{nL}^* - p_{nL}^{**}) [K_2(1-\theta) - \pi_{LH} - \pi_{HL}] \quad (107)$$

$$\pi_{HL} p_L^* v_L - [K_2(1-\theta) - \pi_{LH}] p_H^* v_H = (p_{nH}^* - p_{nH}^{**}) [K_2(1-\theta) - \pi_{LH} - \pi_{HL}] \quad (108)$$

Solving the system of equations (107) and (108) provide the values taken by the degree of management:

$$v_L = - \frac{\pi_{LH} (p_{nH}^* - p_{nL}^*)}{K_2(1-\theta) p_L^*} < 0$$

$$v_H = \frac{\pi_{HL}(P_{nH}^* - P_{nL}^*)}{K_2(1-\theta)P_H^*} > 0$$

These results generalize those of chapter 3. Before the management action, we know that to the position L corresponds a value of the exchange rate which shows a depreciation compared with its level at position H. But because of the anticipations involved, the depreciation is less than the case without anticipations. At the position L, what is required therefore is an action supporting the move for a full stretch of the depreciation as a way to protect the domestic price. This means an increase in the money supply as indicated by the negative sign of v_L . Conversely, at position H, the monetary authorities operate a decrease in the money supply ($v_H > 0$) to appreciate further the exchange rate. As in the previous chapter, we find in the extended model the policy of leaning with the wind as the policy called for in response to commodity price shocks to protect the domestic price index if the commodity price proves to follow a Poisson process.

Conclusion

The extension of the simple monetary model to a two-sector economy has led to consider the trade-theoretic or dependent economy model, in particular with reference to the specification adopted by BG (1990). This is the case of a small open and essentially commodity-exporting economy. The stochastic analysis in continuous-time setting has given an explicit determination and comparison of the objective function, that is the variance

of the domestic price index, under different exchange rate regimes. The choice between the float and the fixed rate regimes is shown to depend on the relative size of the monetary and external shocks. More importantly, the results indicate a way to assess this relative size in comparison to a reference value. Except for very particular cases, the reference value depends on the parameters which characterize the economy such as the speed of adjustment, the price-elasticity of demand and supply on the goods market and the degree of openness of the economy. It appears that the difference of two economies with regards their demand elasticity is determinant for the optimal choice of an exchange rate regime. The context of the FZ economies would call for a more flexible regime than the present peg.

The results also indicate a way to handle the effect that the degree of openness has for the choice of an exchange rate and to clarify the seemingly inconsistent implications between Kenen's and McKinnon's criterion. The former criterion could be qualified as the general rule while the latter would apply only in the case of a very open economy. The numerical simulation in section 4.4 gives support to this result.

An additional step has consisted of introducing the Poisson process in the two-sector model to investigate further the implications of anticipations related to the fluctuations in the commodity price. In fact the two-sector model leads to identify two sources which might call for some degree of management, at least as far as the monetary authorities aim in priority to fight against inflation. The first one results from the presence of the non-traded good, which explains why the spontaneous response of

the exchange rate is not enough to insulate the domestic price. Considering this case has given a more precise basis to the discussion in BG (1990) about the exchange rate policy of "leaning with or against the wind". The policy implications related to the presence of anticipations with a Poisson process in the commodity price behaviour provide a generalization of the results obtained in the simple model of the previous chapter.

Chapter 5 Consistency between saving and exchange rate rules.

Introduction

We know that the FZ countries, because of their fixed exchange rate regime face risks of macro-instability when terms of trade shocks arise. They may view the functioning of their Commodity Marketing Boards or Stabilization Funds as a way to reduce significantly these risks, for example through the sterilization of the foreign reserves fluctuations associated with the change in the price of their main export commodity on the world markets.

This will amount to the question of what would be the optimal saving rule in the context of the FZ exchange rate regime, leading to examine the circumstances if any, under which a flexible exchange rate regime may be called for in addition to the existence of the Stabilization Fund. But the rationale for the establishment of this Stabilization Fund should be addressed in the first place and will be the main concern over the next sections.

The existence of Commodity Marketing Boards or Stabilization Funds constitutes a common feature in developing countries. In general, these have one or two commodities which provide most of their export receipts. In fact, the framework corresponds to our previous description of a typical commodity-exporting economy. The question to be addressed is then to model the functioning of a Stabilization Fund as a tool of macroeconomic management and to look at its link with the exchange rate regime.

It is important to note that this paper will analyze the

Stabilization Fund as it may exist at the national level, for a small, open commodity-exporting economy. The idea of a stabilization mechanism at the international level represents a different issue and will not be a concern here. The two concepts differ fundamentally for the reason that at the national level, the commodity price represents an exogenous variable and is taken as given and there is no attempt to influence the world markets by means of building or destoring inventories.

In what follows, section 1 describes a few features of Stabilization Funds in the FZ countries. Section 2 gives a brief review on the relevant literature while sections 3 to 7 deal with the modelling under different assumptions about the behaviour of the commodity price. The last sections 8 and 9 before the conclusions relate to a comparison with other results of the existing literature and to the case of a flexible exchange rate respectively.

5.1. Some observations on the Commodity Marketing Boards.

As indicated above, our concern will be on Stabilization Funds at the national level. Therefore, considering the quantity of the commodity produced in each period, we assume that it is sold at the prevailing world price. The stabilization mechanism affects the price for the domestic producer so that all the fluctuations in the world price are not passed on directly to the producer. Indeed, for an agricultural product, stabilising the price for the producer is often stated as the "primary aim" of a Stabilization Fund. The implied mechanism is very simple: a tax will be levied in the case of a temporary increase in the world

price and conversely, the Fund would pay a subsidy to the producer to offset the transitory decrease in the export price of the commodity.

To some extent, the situation differs for a mineral resource like oil, where a significant proportion of the export price accrues directly to the Government as a revenue. In consequence, this involves the Government expenditures in goods and services. The Government budget may expand, following an increase in the world price and vice-versa. In this case, the National Budget and the Stabilization Fund are closely interconnected. By contrast, one may consider, in the case of an agricultural product, whether the producer can himself take in charge the task of stabilization via saving and dissaving or if the task should be undertaken by the Government. Bevan, Collier and Gunning (1990) have discussed this issue. Even if the Government operates the stabilization mechanism, there is the possibility of a separation between the Fund and the National Budget. Conceptually, the Fund could exist as a separate and financially independent body which, in face of temporary shocks, will receive the surplus of the export price above the target or long-run level and which spends to close the gap when the export price decreases below the long-run level. In practice however, the functioning will depend on the institutional and administrative links with the National Budget on the basis of which the Fund has been created. In most of the analysis below, it is assumed implicitly that the stabilization mechanism is operated at the Government level.

The Stabilization Fund as it exists in Senegal may provide an

illustration: the CPSP²⁴ has the characteristics of many mechanisms of this type. However the following features may be more specific. For example, the CPSP illustrates the possibility of combining in a unique Fund, the stabilization mechanisms for a variety of products, some exported (e.g groundnut oil and cotton) and others imported such as rice. Also, the CPSP is a separate body for its administration but from the financial point of view and as a matter of fact, it works as a special account of the National Treasurer. In these conditions, its role as a tool of macroeconomic management cannot be guaranteed since positive surplus (export price higher than producer price) may lead to higher level of spending by the Government budget and conversely, so that the export price fluctuations will cause changes in the domestic absorption. In this case where there is actually no stabilization in face of (assumed) temporary shocks, its operations result in shifting the change in spending from the producers to the Government.

Another related question concerns the nature of the expenditures that the Government will undertake with the use of commodity revenue. These may consist of investment outlays or alternatively they may receive the treatment of the ordinary spending of the National Budget. The latter form has received the attention of many observers and it gives strength to the argument according to which the rural sector has for too long subsidized the urban sector: in this case, the Stabilization Fund can be identified as the main channel of the transfer between the two sectors,

²⁴ The acronym CPSP stands for the name of the Stabilization Fund: "Caisse de perequation et de stabilisation des prix"

typically if the domestic price paid to the producer of the agricultural producer is kept low relatively to the trend of the world price.

In most African member countries of the FZ, there exists an account²⁵, the purpose of which is to finance domestic investments and repayments of the Government debt. Its resources come from taxes specifically allocated, for example a given proportion of road taxes, and from external borrowing. But in a country like Ivory Coast, revenues drawn from the coffee and cocoa boom during the 1970's and early 1980's constituted the main resources of this amortization fund. The existence of the account should help to channel the revenue drawn from the commodity exports towards investment and not consumption. But it did both. This is represented in Devarajan and De Melo (1987b) and further, when the commodity prices suffered a severe slump during most of the 1980's, it appeared that current expenditure (wages, subsidies and other spending on goods and services) previously financed from the commodity booms were no longer affordable. However, adjustment tended to be rather slow and so investment and consumption were instead financed by external borrowing.

5.2. Income fluctuations and consumption smoothing: a brief review.

The existing literature has dealt extensively with the question of optimum consumption/saving rule when an agent faces

²⁵ The most used named for this account is: "Caisse Autonome d'Amortissement"

fluctuations in its income. This agent may be an individual consumer, a representative consumer or the Government. We will specifically look at the latter case, but the models corresponding to the three cases share a number of similarities. The model building includes the following steps:

- (i) choice for an utility function
- (ii) determination of the budget constraint
- (iii) characteristic of the income variable in the broad sense of capital and non-capital income.

The utility function depends on the level of consumption and the "consumer", as in a classic optimization problem, seeks to maximize his level of utility, taking account of the income behaviour and the budget constraint.

But let us indicate at this stage that this optimization problem which involves the consumption level as the control variable is to be distinguished from the other category known as the "storage" system or inventory management. Davis and Norman (1990) call this other category the "singular control" type and the former, the "continuous control" type. In the case of inventory management, the system would follow a stochastic process if there were no interventions. In contrast the controller would intervene to keep the level of the inventory above or below a given target or even inside a specific band while seeking to minimize the management cost. The continuous control in its usual form has simply the budget constraint but this may be combined with additional constraints such as borrowing constraints as in Deaton (1991), Hausmann, Powell and Rigobon (1993) or transaction costs as treated by Davis and Norman (1990). Brock (1991) uses a

constant absolute risk aversion utility function and a simple budget constraint combined with capital-accumulation dynamics to look at the effect of export instability on variables such as savings, capital formation and growth.

Before going further on these recent papers, let us indicate the other important step in the modelling exercise, which is the characterization of the income process. On this, a large part of the literature has put much focus on the description of the capital income behaviour. The asset price may be assumed to follow a deterministic process or stochastic process. If the process is stochastic, it constitutes a source of uncertainty to handle by the decision-maker. Most models assume that the consumer is risk-averse so that the situation of uncertainty affects negatively his well-being. Depending on whether the stochastic process is stationary or non-stationary, different methods have been used to solve the maximization problem.

The case of stationary income or asset prices has drawn a great deal of attention and has been closely related to the theory of permanent income and business cycle. Friedman (1957) and Blanchard and Fisher (1989) contain an account of this tradition. The approach has its applications in a number of domains. In particular, a case which will be of special interest for us will be when considering a small commodity-exporting economy for which the terms of trade fluctuate very significantly. Under the assumption that these have the form of a stationary process, the small economy would not change its level of consumption in response to each change in the relative price of its exports. Instead it would optimally smooth its level of consumption by

means of saving and dissaving. A commodity Marketing Board or Stabilization Fund in the small commodity-exporting economy would play the role of saving and dissaving. The farmers' spending would not need to change to accommodate an increase or decrease in the world price of the cash crop, provided the terms of trade fluctuations can be described as temporary shocks. In consequence, modelling Stabilization Funds in the context of stationary terms of trade appears to find a solid theoretical ground.

Now, considering the range of export commodities produced in the mineral sector and in the agricultural sector in different countries, it may happen that the stationarity hypothesis does not hold for all of them. In these conditions, a difficulty arises with the question of how and to what extent it would be optimal and rational for the small economy to have and to operate a Stabilization Fund when the price of its exports proves to follow a non-stationary process. The same question arises about the saving rule for a consumer (an individual or a representative consumer) whose income is non-stationary. Furthermore, one may look for other factors, and the way they would combine with the price/income characteristics to affect the saving rule. In this respect, the existence of borrowing constraints and/or macroeconomic adjustment costs might play a significant role as underlined by Deaton (1991) and Haussman, Powell and Rigobon (1993). We will focus more on these two papers, and their main assumptions and results are presented below.

The Deaton paper makes the following assumptions. First, it introduces an additional constraint, that is the liquidity

constraint which is thought of as representative of various situations including the case of some consumers in U.S. and of small farmers in developing countries. Also, time preferences are assumed to be higher than the market interest rate. With regards the behaviour of the consumer income, the different cases of probability distribution corresponding to independently and identically distributed (iid) income draws, serially correlated income and non-stationary income are analyzed successively.

The main results obtained by the Deaton paper may be summarized as follows:

(i) in a stationary setting where income can be described as iid over time, there will be a motive for saving and dissaving so that consumption will be smoothed.

(ii) in the case the income is stationary but serially correlated, it happens that the basic result about the saving and dissaving rule is the same as under the iid assumption, although in a less effective way.

(iii) with a non-stationary income, consumption will adjust to income and the standard saving behaviour will not apply any more.

In this model, the type of stochastic process followed by income appears as the determinant factor for the saving rule. We note however that the model does not provide explicit solutions and the results are based on simulation techniques.

Hausman, Powell and Rigobon (1993) build a model for the case of Venezuela which is an oil-exporting country. The relevant tests have been undertaken on the series of oil income and price, and the results indicate that these variables can be described

as following a non-stationary process. This means that the current models do not provide a basis for a saving rule as represented for example by the Venezuelan Stabilization Fund. The authors point out the existence of macroeconomic costs that the changes in Government spending may cause, as a factor which could possibly justify the existence and the functioning of the Fund. Their demonstration uses a quadratic utility function, chosen to capture the macroeconomic costs. Our exploration in the next sections of the Commodity Marketing Boards issue will use elements of this approach and of the portfolio method as in Merton (1971). The exploration will therefore involve stochastic calculus with the aim of finding closed-form solutions under assumptions which seem to fit a good description of the conditions in the FZ.

Before coming to that point, the presentation of the Merton method by Davis and Norman (1990) is an important contribution. Consider a consumer who has two assets, a risk-free one such as a bank account, the second one being a risky asset such as a stock the price of which is a geometric Brownian motion process. It is then possible to obtain a closed-form solution to the optimization problem under the budget constraint, for a class of utility functions and where the control variables are the consumption and the share of the risky asset in the total wealth in each period. Davis and Norman (1990) point out the fact that this solution implicitly assumes "instantaneous and free transactions" between the two assets. In a second step, they proceed to analyze the more general case in which transaction costs exist. Although their paper does not derive a closed-form

solution in this general case, the authors indicate how the local times of the stochastic system represent an optimal policy and provide an algorithm for the corresponding derivation. Where the portfolio method is applied, we will assume for simplicity that there are no transaction costs involved.

5.3. The quadratic utility function.

The intertemporal maximization problem usually involves a utility function U of the form:

$$U = E \int_0^{\infty} e^{-\delta t} u(c_t) dt \quad (1)$$

where: E represents the expectation operator, δ the rate of time preference, c_t the level of consumption and u the instantaneous utility function. This is a continuous time setting and one can read U as the expected present value of future utility to be obtained from the stream of consumption over the lifetime span. The function u is generally defined to have the basic property of a monotone, increasing and concave function. This property can be expressed in terms of the positive and negative signs of the first and second order differentials of u respectively: $u' > 0$ and $u'' < 0$. The first condition simply reflects the fact that the consumer will be better off with more consumption everything else being constant. The second condition indicates the risk-averse attitude of the consumer. This means that increased uncertainty will translate into a loss of expected utility.

When written more specifically, the function appears very often as belonging to a set of functions known as the HARA (hyperbolic

absolute risk aversion) family. Hakansson (1970) and Merton (1971) give a formal description of this class of functions. Four of them are the most used in the optimal saving/consumption literature. These are the quadratic function and the following three cases:

(i) $u(c) = c^\eta/\eta$ where η is a parameter and $\eta < 1$. This case belongs to the subset of iso-elastic utility functions, that is, with a constant relative risk-aversion²⁶

(ii) $u(c) = -e^{-\eta c}/\eta$ with $\eta > 0$. This function is of the exponential type which is known to have a constant absolute risk aversion.

(iii) $u(c) = \text{Log}(c)$, which can be obtained as a limit case of the iso-elastic function above when η tends to zero.

The HARA family has the interesting property of providing closed-form solutions to the maximization problem yet, in contrast to most of the other forms of utility functions. Hakansson (1970) notes in his study of cases (i), (ii) and (iii) that this is because these functions are the only solutions to the generalized Cauchy equations. However, the availability of explicit solutions will depend also on the constraints and the type of stochastic process the income or asset price will follow. Merton (1971) obtains closed-form solutions when the system can

²⁶ By definition, the absolute and relative risk aversions are respectively:

$$A(c) = -\frac{u''(c)}{u'(c)}$$

$$R(c) = -\frac{c \cdot u''(c)}{u'(c)}$$

be characterized as stationary and for a few other non-stationary cases, but the budget constraint has the classic form. In the presence of additional constraints such as liquidity constraints, the maximization problem becomes more complex and has not been solved explicitly, except for the stationary case (Hakansson, 1970). Instead, simulation techniques have been used to suggest a solution: Davis and Norman (1990) and Deaton (1991) as already mentioned.

Another difficulty arises where both the asset price and non-capital income display some degree of uncertainty. Skinner (1988) proceeds by Taylor expansion of the Euler condition in addition to the use of iso-elastic utility-function, to get an approximate closed-form solution to this type of problem.

To select a member of the HARA family appears therefore only a step towards an exact solution, not a sufficient condition to obtain it. Still, one may ask the question of which HARA function to choose when it comes to do so. The distinction generally runs between the quadratic utility function and the other HARA elements described in (i), (ii) and (iii) above. The former seems to be less interesting than the latter to handle the situation of risk because its marginal utility does not present any curvature: its third order differential equals zero in contrast to the other cases. Consequently, uncertainty will not affect the optimal behaviour, at least as far as this is represented by the Euler condition: uncertainty will affect the expected utility only. But as we will see, the result differs if the decision variables include the portfolio distribution in addition to the optimal consumption/saving pattern which corresponds to the Euler

condition. Also, the absolute risk aversion of the quadratic utility function increases with the level of consumption²⁷ whereas one would expect the reverse relationship to hold. A final observation concerns the fact that the quadratic function will be defined on a limited range of the control variable values.

To model the handling of a Stabilization Fund in the context of a small commodity-exporting economy, we will adopt a quadratic utility function. The rest of this section will explain the reason of the choice made despite the existence of some disadvantages as just seen.

Apart from the fact that it belongs to the set of functions the most susceptible to provide an exact solution, the quadratic utility function seems to represent best the account of macroeconomic costs which go with change in aggregate spending. Haussman, Powell and Rigobon (1993) give the argument in support of this approach, where the utility function is defined as in equation (1) with²⁸:

$$u(G) = G - \phi G^2/2 \quad (2) \text{ where } G$$

denotes the Government spending and ϕ a positive parameter.

Here follows an illustration on a particular way that may lead to this specification. Let us consider a model, for example the Dornbusch model in which the price adjustment formula takes the form:

²⁷ One may note however that this does not apply to the relative risk-aversion index.

²⁸ Actually, the function defined by Hausmann, Powell and Rigobon is slightly more complex it incorporates different categories of macroeconomic costs.

$$dp/dt = \theta(y-y_0) \quad (3)$$

where: p is the price index

θ the speed of adjustment

y and y_0 represent the desired demand and the full-employment output respectively.

It is possible to show that combining (3) with an appropriate objective function can lead to the utility function in question. For this purpose, let us use the example in S. Black (1985) which represents a trade-off between the level of income or demand y and price stability:

$$V = E(y) - k \cdot \text{var}(p) \quad (4)$$

where $E(y)$ denotes the expected demand and $\text{var}(p)$ the variance of the price index, k giving a measure of the relative aversion of the monetary authorities towards inflation. Here the shocks which affect the system come from the terms of trade fluctuations and this in turn affects the demand side. The variance $\text{var}(p)$ equals:

$$\text{var}(p) = E(dp/dt)^2 = \theta^2 E(y-y_0)^2 \quad (5)$$

Substituting (5) in (4) gives:

$$V = E(y - k\theta^2(y-y_0)^2) \quad (6)$$

Equation (6) provides a utility function similar to (2) if one takes the expectation operator into account²⁹. It represents the type of trade-off at the macroeconomic level which will concern the Authorities of the commodity-exporting economy. Comparatively

²⁹ There is the difference between y (equation 6) and G (equation 2) however. But G is an element of the demand y and since the focus here bears on the Stabilization Fund, one can argue that y may be replaced by G .

to the analysis in chapters 3 and 4, the objective function considered there consists of the domestic price variance only whereas equation (4) or (6) incorporates the desirable outcome of higher consumption and compares it with the cost of price instability which may result.

After the choice for the utility function, the next step will consist of considering different assumptions about the budget constraint and the behaviour of the commodity price, and solving correspondingly the optimization problem.

The deterministic case is the simplest one to start with. Throughout the modelling exercise, the continuous time setting will be used. Also, in the next sub-sections till sub-section 8, we assume the case of a fixed exchange rate so that the domestic export price and the world market price are identical.

5.4. Deterministic case.

We assume that the Government seeks to maximize the following utility U :

$$U = \int_0^{\infty} (G - (\phi/2)G^2) e^{-\delta t} dt \quad (7)$$

under the budget constraint:

$$dS/dt = rS + y - G \quad (8)$$

with the following notations:

U clearly represents the present value as of time zero of discounted future streams of utility.

G : level of Government spending. The case where G represents aggregate consumption could be handled easily. Indeed although

in strict terms the model would refer to the part of aggregate spending of the small economy which is directly influenced by the fluctuations in the terms of trade, such a notation would be acceptable when we assume, referring back to the model in chapter 4, that the degree of openness of the economy (the parameter $1-\lambda$ in chapter 4) does not change so that the aggregate demand is linked directly to the terms of trade.

ϕ : indicator of the trade-off between the level of consumption and the adjustment costs due to variation in consumption.

δ : the rate of time preference.

S : the level of saving holdings by the Stabilization Fund. These savings provide interest earnings at the rate r .

y : the export receipts or income.

The uncertainty in the variable y comes from the fluctuations in the commodity price and production level. But very often, as far as the stabilization mechanism is concerned, only the uncertainty in the commodity price will matter. So where necessary, we can assume that the production level is constant. The budget constraint (8) shows how in each period the total income $rS+y$ (interest earnings and income) will be used up between spending on goods and services G and increasing the level of savings by dS/dt .

As already indicated, the definition of the quadratic utility function will hold only for a limited range for the variable G , namely between zero and $1/\phi$. At first sight, this might seem very restrictive. In practice, one can get around of the restriction by means of an appropriate scaling of the variable G . For example, G may be defined in terms of consumption per

capita.

The model does not involve a liquidity constraint: it allows for negative values of S : one may denote $-S$ as the Government debt and in a way, this is to simplify the analysis. However, the context of the FZ can justify such an assumption. Indeed, the FZ countries have instituted between them a system whereby their external reserves are pooled, and also they benefit from the guarantee by France of the CFA convertibility. This means a particular country can be allowed to run an external deficit provided the overall situation of the group as a whole remains favourable. Consequently, the FZ countries do not experience the type of reserve constraint for their need of imports they would otherwise do. But the need for adjustment in the long run should apply to any of these countries. In other terms and in the context of this model, the accumulation of savings and external reserves will not constitute an objective itself on the one hand and on the other hand, the Government debt should not be allowed to "explode". How does the model account for the long run condition?

To bring about an answer to this question, let us take the integral of the dynamic budget equation. It follows the expression below:

$$\int_0^{\infty} G(t)e^{-rt}dt = S(0) + \int_0^{\infty} Y(t)e^{-rt}dt \quad (9)$$

Equation (9) represents the intertemporal budget constraint which insures that the appropriate balance as stated above will hold in the long run. It equates the present value of the future

streams of consumption to the sum of the initial wealth level and the present value of the stream of future income streams. This may be viewed as equivalent to the "No-Ponzi-Game" condition (Blanchard and Fisher, 1989) whereby the debt growth rate should not exceed the interest rate, asymptotically.

Let us restate the maximization problem in which G represents the control variable as follows:

$$\text{Max } \int_0^{\infty} (G - (\phi/2)G^2) e^{-\delta t} dt \quad (7)'$$

G

$$\text{s.t. } dS/dt = rS + y - G \quad (8)'$$

The notations are the same as above.

To solve the deterministic problem, the use of the Hamiltonian technique will suffice. For this purpose we define the variable H as below:

$$H = (G - \phi G^2/2) e^{-\delta t} + \lambda (rS + y - G) \quad (10)$$

where λ denotes here the multiplier corresponding to the dynamic equation (8)'.

The first order conditions of the maximization problem will be:

$$\partial H / \partial G = 0 \quad (11)$$

$$\partial H / \partial S = -d\lambda/dt \quad (12)$$

Expliciting (11) and (12) will bring about:

$$(1 - \phi G) e^{-\delta t} - \lambda = 0 \quad (11)'$$

$$\lambda r = -d\lambda/dt \quad (12)'$$

After substitution of (11)' into (12)', it follows that:

$$\frac{dG}{dt} = \frac{r-\delta}{\phi} (1-\phi G) \quad (13)$$

Expression (13) gives the proper dynamics of the consumption variable. It will be used to derive the consumption level as a function of the level of wealth. To do so, we need a rearrangement of equation (9) as of time t instead of time zero:

$$\int_t^\infty G(u) e^{-r(u-t)} du = S(t) + \int_t^\infty Y(u) e^{-r(u-t)} du \quad (14)$$

Transforming the first integral by parts will give:

$$\int_t^\infty G(u) e^{-r(u-t)} du = [-G e^{-r(u-t)} / r]_t^\infty + (1/r) \int_t^\infty G(u) e^{-r(u-t)} du \quad (15)$$

Substituting (13) into (15) leads to:

$$\int_t^\infty G e^{-r(u-t)} du = \frac{G}{r} + \frac{r-\delta}{r\phi} \left[\int_t^\infty e^{-r(u-t)} dt - \phi \int_t^\infty G e^{-r(u-t)} dt \right] \quad (16)$$

or equivalently:

$$\int_t^\infty G e^{-r(u-t)} du = \frac{G}{r} + \frac{(r-\delta)}{r^2\phi} - \frac{r-\delta}{r} \int_t^\infty G e^{-r(u-t)} dt \quad (17)$$

If we denote by $w(t)$ the level of wealth

$$w(t) \equiv S(t) + \int_0^\infty Y(u) e^{-r(u-t)} du \quad (18)$$

then combining (16) and (17), we can derive from (14) the relationship of G with respect to the level of wealth:

Result 1

$$G = (2r - \delta)w - \frac{(r - \delta)}{r} \frac{1}{\phi} \quad (19)$$

Equation (19) displays G as a linear function of w . The linear relationship is exactly the type of result obtained with the HARA functions described above. Equation (19) to make sense needs the additional assumption that $2r - \delta \geq 0$. This does not seem to be restrictive. In practice, the interest rate and the rate of time preference are deemed to be very close. If there was the equality $r = \delta$ as it would tend to be the case for an open economy, then equation (19) would take the simple form:

$$G = rw \quad (18)'$$

In the representation of an impatient consumer, described by Deaton (1991) to fit the situation of small farmers in developing countries, the rate of time preference is larger than the interest rate: $\delta - r \geq 0$. Consequently, from equation (19) we can see that a higher aversion towards inflation or other macroeconomic costs, that is a higher value of the parameter ϕ will result in a lower level of consumption for every given value of wealth w .

The main result may be summarized as follows: the relationship between G and w implies that consumption will smooth the variations in export receipts. This justifies the setting up of a Stabilization Fund to play the smoothing role, saving in periods when income is higher than the trend of future incomes and dissaving when income is lower than the trend.

An illustration of this can be seen by assuming that $r = \delta$ so that equation (13) reduces to:

$dG/dt = 0$ or equivalently that G equals a constant G_0 . Then a

change in y will not affect the level of consumption and will be passed on entirely as a change in saving: $dS/dt = rS + y - G_0$. An increase in y leaves the level of consumption unchanged. Instead the saving flow dS/dt will increase.

5.5. Stochastic case with stationary export receipts.

The first step to extend the previous analysis will consist of introducing uncertainty in the model. The export receipts will be assumed to follow a stochastic process. Not only for the FZ countries but many other small economies have experienced shocks on their export receipts. Very often, the shocks take the form of fluctuations in the commodity price. But in a number of cases, the change has also concerned the quantity produced or exported, due to natural calamities such as droughts.

We will adopt a new notation whereby the flow of export receipts or income will be dy . This leaves a possible interpretation of $y(t)$ as the cumulative level of export receipts in the period $[0, t]$, while dy denotes the flow during the period dt .

In the stochastic setting, the maximization problem takes the form:

$$\text{Max } E \int_0^{\infty} (G - (\phi/2)G^2) e^{-\delta t} dt \quad (20)$$

G

$$\text{s.t. } dS = rSdt + dy - Gdt \quad (21)$$

The Government will seek to maximize, under the budget constraint, the expected net utility derived from the different levels and variations of consumption over time: this is

represented by (20) and (21) where E indicates the expectations operator, S, r and δ denote as before the saving holdings, the market interest rate and the rate of time preference.

By the assumption of stationarity, we will mean that the export receipts will in this logarithmic notation follow the process:

$$dy = \alpha dt + \sigma dz \quad (22)$$

where α and σ are two constants. The variable $z(t)$ is a standard Wiener process so that the variable $y(t)$ can be described as a brownian motion or diffusion process with drift α and variance σ^2 . The export receipt flow has two components: the expected export receipts αdt and the unexpected element σdz . The budget equation (21) takes then the form:

$$dS = (rS + \alpha - G)dt + \sigma dz \quad (21)'$$

Note that in general the shocks on the export receipts will come from two sources: the shocks on the commodity price on the world market on the one hand and the shocks on the production of the commodity itself. A priori, one may think of dy as equal to:

$$dy = (\alpha_1 + \alpha_2)dt + \sigma_1 dz_1 + \sigma_2 dz_2$$

where α_1 and $\sigma_1 dz_1$ relate to the commodity price while α_2 and $\sigma_2 dz_2$ relate to the commodity production, assuming that the two variables are independent for a small economy. Then it suffices to reinterpret α and σdz as equal successively to: $\alpha = \alpha_1 + \alpha_2$ and

$$\sigma dz = \sigma_1 dz_1 + \sigma_2 dz_2.$$

In the procedure to find a solution, we define as in Merton (1971) a value function in a way similar to the maximization problem except that it will be considered as of time t instead of the initial period zero. We denote the value function by $V(S, t)$:

$$V(S, t) = \text{Max}_G E \int_t^\infty (G - (\phi/2)G^2) e^{-\delta t} dt \quad (23)$$

G

$$\text{s.t. } dS = (rS + \alpha - G)dt + \sigma dz \quad (24)$$

The next step will consist of writing the Bellman equation of dynamic programming for our maximization problem, to be solved for the function $V(S, t)$ as follows:

$$\text{Max}_G (G - \frac{\phi}{2}G^2) e^{-\delta t} + V_t + (rS + \alpha - G) V_s + \frac{\sigma^2}{2} V_{ss} = 0 \quad (25)$$

where V_t , V_s and V_{ss} are differentials of V :

$$V_t \equiv \partial V / \partial t; V_s \equiv \partial V / \partial S; V_{ss} \equiv \partial^2 V / \partial S^2.$$

The first order condition to obtain the optimal value of G gives:

$$(1 - \phi G) e^{-\delta t} - V_s = 0 \quad (26)$$

which leads to:

$$G^* = [(1 - e^{\delta t}) V_s] / \phi \quad (27)$$

Replacing back into (25), it follows the partial differential equation for $V(S, t)$:

$$\frac{e^{-\delta t}}{\phi} - \frac{V_s}{\phi} - \frac{\phi}{2} \left(\frac{e^{-\delta t}}{\phi^2} - \frac{2}{\phi^2} V_s + \frac{e^{\delta t}}{\phi^2} V_s^2 \right) + V_t + (rS + \alpha + \frac{e^{\delta t}}{\phi} V_s - \frac{1}{\phi}) V_s + \frac{\sigma^2}{2} V_{ss} = 0 \quad (28)$$

or equivalently:

$$\frac{e^{-\delta t}}{2\phi} + V_t + (rS + \alpha - \frac{1}{\phi}) V_s + \frac{e^{\delta t}}{2\phi} V_s^2 + \frac{\sigma^2}{2} V_{ss} = 0 \quad (29)$$

To solve the differential equation (29), we consider a trial solution. One advantage of the HARA utility functions is that the value function such as $V(S, t)$ will have the same form as the utility function. Our trial solution will therefore take the form:

$$V(S, t) = e^{-\delta t} (A_0 + AS + BS^2) \quad (30)$$

where A_0 , A and B are constants to be determined.

Using (30) in (29) and considering the identity to zero gives a system of three equations which will provide the values of A_0 , A and B :

$$\frac{1}{2\phi} + \frac{A^2}{2\phi} + (\alpha - \frac{1}{\phi}) A - \delta A_0 + \sigma^2 B = 0 \quad (31)$$

$$\frac{2AB}{\phi} + (r - \delta) A + 2(\alpha - \frac{1}{\phi}) B = 0 \quad (32)$$

$$\frac{2B}{\phi} + 2r - \delta = 0 \quad (33)$$

This implies in particular:

$$B = -\frac{\phi}{2} (2r - \delta) \quad (34)$$

and

$$A = -\frac{(\alpha\phi-1)}{r}(2r-\delta) \quad (35)$$

The combination of (34) and (35) with equation (27) provides the optimal value G^* :

Result 2

$$G^* = (2r-\delta)\left(S + \frac{\alpha}{r}\right) - \frac{(r-\delta)}{r} \frac{1}{\phi} \quad (36)$$

The solution G^* appears as a linear function of the saving stock S . We note the similarity with the solution in the deterministic case (equation 19). The term α/r can be viewed as the stream of expected future export receipts so that the value $S+\alpha/r$ will correspond to the wealth $w(t)$. Again, the optimal consumption level will not follow one for one the fluctuations of income or export receipts and this will result in savings and dissavings depending on whether the current export receipts are higher or lower than the long run trend α .

We note also that the uncertainty indicator σ does not enter the expression of G^* . This reveals the property of certainty equivalence that this model has. We know that the two characteristics which result in the certainty equivalence are the quadratic form of the utility function combined with the linearity of the budget constraint. However, because of the

concavity of the utility function, the value function will depend on the variance σ^2 as can be seen in equation (31), which determines the constant A_0 .

The final observation relates to the debt problem treated in the optimization literature. Blanchard and Fisher (1989) gives an outline of the approach. Our specification can be reinterpreted to deal with the debt and current account issue. Let us take the small economy with a large export sector in which one commodity is predominant. To a large extent, $-S$ can be viewed as the external debt and $-dS/dt$ as the current account deficit. In the budget constraint, the variable G would represent the aggregate spending, that is consumption and investment at the macroeconomic level. Suppose the net between production and consumption of the non-export sector is constant and normalized to zero. Then the budget equation would resemble the resource - spending identity of the national accounts just like in the specification of the debt problem.

5.6. Non-stationary case.

On the basis of the solutions derived above, the theoretical results about the optimal consumption/saving in the FZ countries provide a characterization and a justification of the Stabilization Funds. But that holds so far as the deterministic case or the stationary case appear representative enough. The present subsection deals with the alternative situation in which the export receipts follow instead a non-stationary process as it may happen in some if not all of the FZ countries. In general, the existing literature faces a great difficulty in solving the

non-stationary case. In what follows, we take the example of a non-stationary process which can be solved explicitly³⁰

Let us assume that the export receipts follow the process:

$$dy = Xdt + \sigma_1 dz_1 \quad (37)$$

where the instantaneous value of exports is not constant but instead it will follow a stochastic process in the form:

$$dX = a dt + \sigma_2 dz_2 \quad (38)$$

This describes a situation in which expectations have not "settled down" and are still adjusting. Thus typically, the stationary case would describe the long run equilibrium while the short run description would introduce the specification in (37) and (38). In the present model, both y and X are brownian motions with the variances σ_1^2 and σ_2^2 . Let assume that both variables are observable. If X was not observable, then arises the problem of partial observations, the solution of which requires the application of the separation principle and the Kalman-Bucy filter (Fleming and Rishel, 1975).

If now we consider the budget equation, it can be rewritten, taking account of equation (37), as follows:

$$dS = (rS + X - G)dt + \sigma_1 dz_1 \quad (39)$$

Then we define a new state variable H :

$$H = rS + X \quad (40)$$

Differentiating the two sides of (40) and using (38) gives:

$$dH = r dS + dX = r[(rS + X - G)dt + \sigma_1 dz_1] + a dt + \sigma_2 dz_2 \quad (41)$$

Using the definition of H and substituting in (41), it follows

³⁰ Some other special cases are solved in Merton (1971).

that:

$$dH = r(H-G)dt + r\sigma_1 dz_1 + a dt + \sigma_2 dz_2 \quad (42)$$

or equivalently:

$$dH = (rH + a - rG)dt + r\sigma_1 dz_1 + \sigma_2 dz_2 \quad (43)$$

Following the same procedure as in the stationary case, it is possible to derive the optimal level of consumption:

$$G^* = \frac{1}{r} (2r - \delta) \left(H + \frac{a}{r} \right) - \frac{r - \delta}{r} \frac{1}{\phi} \quad (44)$$

The solution appears as a linear function of H and therefore it does not reflect exactly the fluctuations in the variables y or X . Indeed beside the variable H , only the expected stream of future export receipts a/r enters the expression (44). This result again allows for a saving scheme and the existence of a Stabilization Fund. The most important aspect of this result is probably that a non-stationary (non-capital) income does not necessarily imply that consumption should adjust instantly and fully to income, leaving no place for a saving scheme.

The combination of a quadratic utility function which takes into account the macroeconomic costs and a budget constraint specified with non-stationary export receipts proves to have maintained the rationale for a Stabilization Fund.

5.7. Portfolio method.

The previous analysis might be extended to the case where we consider that the economy has two assets instead of one. Bevan, Collier and Gunning (1990) address the issue of temporary

shocks in the context of a small economy which receives a significant part of its income from exports. The authors consider two forms of savings to describe the stabilization scheme which should be in place in the case of temporary shocks: savings in the form of foreign asset acquisitions or alternatively (physical) investments in the domestic economy. At the same time, we will look at different ways of specifying the behaviour of the shocks.

Below, we propose a formal treatment of the question as a portfolio decision. The two types of assets will be a risk-free asset such as bond holdings and a risky asset which will consist of investment in the export sector. Note a slight difference with the presentation of Bevan, Collier and Gunning (1990) where the investments are supposed to go mainly into the non-tradable sector. But assuming full competition between the sectors for the use of the available resources, we can get the equalization of the marginal products of any given factor across the economy. Under these conditions, the choice of the sector will matter less as long as our concern focuses on the return of the investment. However we are aware of the problem of inflation pressures which may result from the investments in the non-tradable sector in contrast to the case where the investments take place in the export sector, raising no serious problem of inflation pressures. To rule out the inflation problem in the former situation, we need to make sure that an investment in the non-traded sector translates quickly enough in the production of goods and services.

Also, the introduction of two assets in the economy could

receive a more general interpretation. The risk-free asset may include the investments in any competitive enough sector (including the bonds market) which faces much less or no uncertainty with regards its returns, compared with the degree of uncertainty affecting the export sector. In this general perception, the risk-free asset would be representative of the sectors with relatively negligible uncertainty regarding the return on investment while the export sector or the risky asset would be representative of all the other sectors of the economy. Such a presentation would have the advantage to allow for the existence of two goods at least in the economy. In what follows, we set up the form of the budget equation of this two-asset model and solve the maximization problem.

a. Budget constraint

The source of uncertainty about the return of the risky asset will come, as in the previous subsection, from the uncertainty in the production of the sector on the one hand and on the other hand from the fluctuations in the commodity price on the world market.

The variables S and k will denote the stocks of the risk-free and risky assets respectively. The total wealth will be represented by the variable w and will be defined as the sum of the two asset stocks:

$$w = S + k \quad (45)$$

Or alternatively, one might write:

$$k = \omega w \quad (46)$$

$$S = (1 - \omega)w \quad (47)$$

where ω is the share of the risky asset in the total wealth.

The return in the export sector is defined per unit of existing capital and might be specified as follows:

$$\frac{dy}{k} = \alpha_1 dt + \sigma_1 dz_1 \quad (48)$$

The idea of a stochastic return from a production technology as indicated in equation (48) is presented in Stulz (1986).

Note that the drift term α_1 represents the instantaneous level of export receipts per unit of capital in the export sector, to compare with the drift terms α or X above which correspond to the total value of export receipts. In this respect, α_1 compares with the market interest rate r (return of the other asset) better than α or X because it has actually the meaning of a return on an asset. Also we may think of dy per unit of capital dy/k as a capital gain from two sources: a productivity gain dq/k where dq would represent the new output or export quantity flow on the one hand and an increase in the commodity stock price p_x , dp_x/p_x on the other hand:

$$dy/k = dq/k + dp_x/p_x.$$

Then assuming that: $dq/k = \alpha_1' dt + \sigma_1' dz_1$

$$dp_x/p_x = \alpha_2' dt + \sigma_2' dz_2$$

it will follow that dy/k can be interpreted as in equation (48). With these different notations, the budget constraint can be written as follows:

$$dw = rSdt + k(dy/k)dt - Gdt \quad (49)$$

Equation (49) could be rewritten in the form:

$$dw = rSdt + dy - Gdt \quad (49)'$$

to show the similarity to a large extent with the previous specification of the budget constraint. But the term dw on the left hand side instead of dS introduces the portfolio decision in addition to the consumption/saving decision. Typically, the decision-maker will have to decide simultaneously on two variables: the level of consumption G and the share ω of the risky asset. However the condition of non-explosion of the debt continues to hold. It suffices to integrate the budget constraint and to take the expected value on each side.

Let us now rewrite equation (49), introducing the variable ω :

$$dw = r(1-\omega)w dt + \omega w(dy/k) - Gdt \quad (50)$$

Replacing the term dy/k in (50) by its expression in (48) gives:

$$dw = r(1-\omega)w dt + \omega w(\alpha_1 dt + \sigma_1 dz_1) - Gdt \quad (51)$$

or equivalently:

$$dw = \omega w(\alpha_1 - r)dt + (rw - G)dt + \omega w\sigma_1 dz_1 \quad (52)$$

In the new set-up, the interpretation of the term dy has changed from the representation of non-capital income to the meaning of capital income. In general such a transition is obtained by assuming that non-capital or labour income is diversifiable, and doing so makes the maximization problem much easier to solve. The holding of assets such as life insurance may portray ways in which the diversification of labour risk could be constructed. But to consider that all labour income risk would be diversifiable is not a generally accepted assumption in the existing literature: Blanchard and Fisher (1989). In the present

model where dy refers to the export receipts, the transition from one definition to the other raises less difficulty. After all, the production in the export sector is derived from an existing stock of capital, essentially land, and there is a market for land. Conversely, if we take the stock of capital as given and equal to k_0 , then this would amount to reducing the use of export receipts for consumption and for saving in the risk-free asset only, that is, the one-asset model analyzed earlier on.

b. Solution of the maximization problem.

The maximization problem will be written as follows:

$$\begin{aligned} \text{Max } E \int_0^\infty (G - (\phi/2)G^2) e^{-\delta t} dt \\ G, \omega \end{aligned} \quad (52)$$

$$\text{s.t. } dw = \omega w(\alpha_1 - r)dt + (rw - G)dt + \omega w \sigma_1 dz_1$$

To solve this problem, we will follow a number of steps, starting by defining a value function $V(w, t)$:

$$\begin{aligned} V(w, t) = \text{Max } E \int_t^\infty (G - (\phi/2)G^2) e^{-\delta t} dt \\ G, \omega \end{aligned} \quad (53)$$

$$\text{s.t. } dw = \omega W(\alpha_1 - r)dt + (rw - G)dt + \omega w \sigma_1 dz_1$$

One can easily show this other equivalent expression of $V(w, t)$:

$$\begin{aligned} V(w, t) = \text{Max } \{ -(\phi/2) E \int_t^\infty (G - (1/\phi)G^2) e^{-\delta t} dt + \text{Constant} \} \\ G, \omega \end{aligned} \quad (53)'$$

$$\text{s.t. } dw = \omega W(\alpha_1 - r)dt + (rw - G)dt + \omega w \sigma_1 dz_1$$

with the constant term equal to $-2/(\phi\delta)$.

Considering the expression (53)' which give the same solutions as (53) and ignoring the constant term will facilitate the calculations. The corresponding Bellman equation will be:

$$\text{Max}_{G, \omega} - \frac{\phi}{2} \left(G - \frac{1}{\phi}\right)^2 e^{-\delta t} + V_t + [\omega w (\alpha_1 - r) + r w - G] V_w + \omega^2 w^2 \frac{\sigma_1^2}{2} V_{ww} \quad (54)$$

The first order conditions giving the solutions G^* and ω^* appear as:

$$G^* = \frac{1 - e^{\delta t} V_w}{\phi} \quad (55)$$

$$\omega^* w = -(\alpha_1 - r) \frac{V_w}{\sigma_1^2 V_{ww}} \quad (56)$$

Replacing back into (54) then gives the partial differential equation for $V(w, t)$:

$$-\frac{e^{\delta t} V_w^2}{2\phi} + V_t + [-(\alpha_1 - r)^2 \frac{V_w}{\sigma_1^2 V_{ww}} + r w + \frac{e^{\delta t} V_w}{\phi} - \frac{1}{\phi}] V_w + \frac{(\alpha_1 - r)^2 V_w^2}{2\sigma_1^2 V_{ww}} = 0 \quad (57)$$

To find the solution of equation (57), we will proceed again with a trial solution such as:

$$V(w, t) = K e^{-\delta t} [-w + 1/(r\phi)]^2 \quad (58) \quad \text{where } K \text{ is a constant to be determined.}$$

Substituting (58) into (57) leads to an equation in K :

$$-\frac{2K^2}{\phi} - \delta K - \frac{1}{2} (\alpha_1 - r)^2 2 \frac{K}{\sigma^2} + 2rK + \frac{4K^2}{\phi} = 0 \quad (59)$$

which implies that:

$$\Rightarrow K = \frac{\phi}{2} \left[\delta - \left(2r - \frac{(\alpha_1 - r)^2}{\sigma_1^2} \right) \right]$$

and therefore:

$$V(w, t) = \frac{\phi}{2} \left[\delta - \left(2r - \frac{(\alpha_1 - r)^2}{\sigma_1^2} \right) \right] e^{-\delta t} \left(-w + \frac{1}{r\phi} \right)^2 \quad (60)$$

From the first order conditions (55) and (56) and considering the expression (60) of the value function, it follows that the optimal values of consumption and portfolio share will be:

Result 3

$$G^* = \left(2r - \delta - \frac{(\alpha_1 - r)^2}{\sigma_1^2} \right) w - \frac{1}{r} \left[r - \delta - \frac{(\alpha_1 - r)^2}{\sigma_1^2} \right] \frac{1}{\phi} \quad (61)$$

$$\omega w = \left(\frac{\alpha_1 - r}{\sigma_1^2} \right) \left(-w + \frac{1}{\phi r} \right) \quad (62)$$

In the expression (61), we find again the optimal level of consumption G^* as a linear function of w , the level of wealth. As previously, we will assume that the coefficient of w is positive:

$$2r - \delta - (\alpha_1 - r)^2 / \sigma_1^2 > 0$$

The linear relationship with the level of wealth implies the existence of savings/dissavings, that is, the operation of a Stabilization Fund in the context of a small commodity-exporting

economy subject to commodity export shocks.

The effect on G^* of the risk aversion towards inflation ϕ will depend on the sign of the term:

$$r - \delta - (\alpha_1 - r)^2 / \sigma_1^2.$$

There is some presumption that it has a negative sign (for example $r - \delta < 0$ with impatient consumers), in which case higher values of ϕ will cause a lower value of G^* , everything else remaining constant. The same conclusion holds in particular when $r = \delta$, about the way the trade-off operates between the benefit derived from higher levels of consumption on the one hand and the related adjustment costs which are

represented in the utility function by $G^2/2$, on the other hand.

With regards the amount of the wealth which will go into the export sector in the form of the risky asset investment, a positive relationship with the average return α_1 or for that matter the differential return $\alpha_1 - r$ between the risky and risk-free sectors. This conforms the view that a boom (with higher values of α_1) leads to a reallocation of resources in favour of the booming sector. However, the uncertainty does penalise the exposed sector since expression (62) clearly shows that the optimal share will decrease if the variance σ_1^2 increases.

c. Effects of uncertainty and wealth.

We can see that the two-asset model has led to a result which involves the variance σ_1^2 of the export receipts. This is a new feature in comparison to the result obtained in the one-asset model. As already suggested, the difference comes from the fact

that the optimality condition of the one-asset model operates through the marginal utility which is itself linear and therefore the variance of the stochastic process has no effect on the optimal solution. In the two-asset model by contrast, there is an additional non-linear first-order condition, and the two optimality conditions simultaneously determine the solution, which explains the presence of σ_1^2 in the equations (61) and (62).

One would generally expect from a risk-averse behaviour to defer more consumption from the present to the future in face of more uncertainty. The result of equation (61) is compatible with such a prediction. The differential of G^* with respect to the variance σ_1^2 gives:

$$\frac{dG^*}{d\sigma_1^2} = -\frac{(\alpha_1 - r)^2}{\sigma_1^4} \left(-w + \frac{1}{r\phi} \right) \quad (63)$$

The sign of this differential can be determined quite easily. We recall that the domain of validity for the utility function implies that the inequality below holds:

$$G^* < 1/\phi$$

It can be shown that $G^* - 1/\phi < 0$ leads to the inequality $w - 1/(r\phi) < 0$. Consequently G^* appears as a decreasing function of the variance σ_1^2 .

With regards the solution ω^* , we consider the condition $-w + 1/(r\phi) > 0$. Also our presumption is that the instantaneous return of the risky asset will be higher than the return of bond asset otherwise the investors would tend to prefer markedly the latter asset. In consequence the term on the right hand side of equation (62) will generally have a positive sign. The share of

the risky asset will reduce to zero when $\alpha_1 = r$. However, if the return α_1 happens to be lower than r , then there will be "shortselling" on the risky asset. This will lead to a negative stock of the risky asset and as a result we will have: $\omega^* \leq 0$. Conversely, when the difference $\alpha_1 - r$ is sufficiently attractive, up to the point of outweighing the uncertainty attached to the risky asset, then borrowing ("leverage") may occur on the bond asset so that the share ω^* will be higher than one: $\omega^* \geq 1$.

Under the assumption that $\alpha_1 > r$, the optimal share will appear as a decreasing function of σ_1^2 and also of ϕ . The former relationship is easy to understand since more uncertainty will make the risky asset less attractive. For the latter relationship, higher aversion with respect to adjustment costs should mean a reduction in the proportion of wealth held in the risky asset. Indeed, it is this risky asset which constitutes the source of the shocks and consequently the cause of adjustments.

Finally, we could also note that the optimal share ω^* of the risky asset will be a decreasing function of the level of wealth. This seems to be a consequence from the specification of the utility function as a quadratic one. As we know already, for this type of utility function, the absolute risk aversion increases with the level of wealth. But more interestingly, the relationship of ω^* with respect to w could mean that the economy will diversify itself as it grows. Indeed more diversification reduces the exposure of the economy to the external shocks. This line of argument is precisely the one used by Kenen (1969) and referred to amply in chapters 2 and 4. Also Branson (1980) found that the terms of trade shocks are more acute for countries at

low levels of income per capita. As a matter of fact and for the sake of further illustration, let us simply indicate that developed countries have more diversified economies than developing countries and are less prone to external shocks.

5.8 More on the stabilization aspect and other characteristics

(i) In solving the optimization problem above, we have at the same time provided the elements of answer regarding the insulation feature of a Stabilization Fund. Two cases need to be distinguished: the one asset model and the portfolio model. The former indicates by means of Results 1 & 2 that the optimal level of consumption G does not depend on the degree of uncertainty σ^2 . This suggests that the Stabilization Fund can insulate from the commodity price shocks if the savings go to a (unique) risk-free asset only (a bond in foreign currency for example).

By contrast, the portfolio model indicates that the combination of a risk-free asset with a risky asset gives a different result. This time the optimal solution G as shown in Result 3 is a decreasing function of σ^2 . The uncertainty displayed by the commodity price in the world market affects negatively the small economy despite the existence of the Stabilization Fund. This means the insulation that the latter provides is not complete: the investment in the export sector may give a substantial level of return but this is subject to fluctuations due to the shocks on the export price. Then the introduction of a flexible exchange rate may be appropriate as the next section 5.9 will discuss.

(ii) The scope of the results obtained in the previous sections is not limited to the stabilization aspect. They seem to give

also some useful indications about other questions addressed by the literature, especially on the effects of export instability on a small open economy. Brock (1991) is most notable for having attempted a theoretical framework on this issue. He then compares the results of his model with the results of the existing and mostly empirical literature (which uses cross-section data) on the effects of export instability. Let us introduce our results in this comparison. Consider the effect of export instability on capital and savings for example. Brock indicates that the capital stock will decrease with the variance of export. This is the same as our finding in Result 3 that the share of capital in the total wealth will decrease with σ^2 . The comparison in Brock (1991) considers also the investment expenditures. But our model has not dealt explicitly with this variable.

With regard savings, the effect of export instability is ambiguous in Brock (1991) while generally the empirical literature finds a positive effect. One exception reported by Brock is the study by Moran (1983) which finds different results depending on the source of the export instability: positive effect when considering the price component of export fluctuations but negative effect with the quantity component of these fluctuations. Brock (1991) seems to favour the latter case on the basis of his argument about the importance of the capital risk. On this point about the effects on savings, our findings indicate clearly that the optimal consumption level G will decrease with σ^2 and consequently saving will increase with export instability. This is consistent with the empirical literature, including Moran (1983) since our analysis deals with

the price component of export instability as well.

5.9 Case of a flexible rate

The portfolio model above has indicated that the Stabilization Fund in a fixed rate regime would not be enough to insulate the small open economy from the commodity price shocks. Then the combination of a Stabilization Fund with a flexible exchange rate regime might insulate more the economy in question. To examine the conditions under which the exchange rate may matter, let us specify further the way the economy works, namely a case of complete specialization whereby the small economy produces only the commodity good and exports all its production. It uses the export to buy import goods for consumption and (physical) capital formation in the export sector. In such a context, the exchange rate will not matter if the risk-free asset is set in foreign currency. Indeed, any element of the capital stock can be expressed as a tradable and its price (or the return of the capital stock) in foreign currency does not vary with the exchange rate. Consequently, the arbitrage between the two assets to decide of the optimal portfolio will not depend on the exchange rate. By contrast, the exchange rate will matter if the risk-free asset is in local currency denomination because the return on the risky asset in local currency will be affected by changes in the exchange rate. In the latter case, the stochastic process which describes the behaviour of the return in domestic currency of the risky-asset (that is the capital installed in the export sector) will have two components: one related to the commodity price in foreign currency and another one related to

the exchange rate. Equation (48) can then take the form:

$$\frac{dy}{k} = (\alpha_1 + \alpha_2) dt + \sigma_1 dz_1 + \sigma_2 dz_2 \quad (48)'$$

where $\alpha_1 dt$ and $\sigma_1 dz_1$ correspond to the drift and stochastic terms for the commodity price fluctuations in foreign currency while $\alpha_2 dt$ and $\sigma_2 dz_2$ relate to the exchange rate process. The parameter α_2 may be chosen to measure the difference between the drift of the flexible exchange rate and the constant term which characterises the fixed regime. The latter may include the case of a crawling peg in which the exchange rate is depreciated or appreciated over time at a constant rate. A negative value of α_2 would typically mean that the corresponding fixed exchange rate regime results in an overvaluation.

Let us rewrite (48)' in a more compact form:

$$\frac{dy}{k} = \alpha dt + \sigma dz \quad (48)''$$

where $\alpha = \alpha_1 + \alpha_2$

$$\sigma dz = \sigma_1 dz_1 + \sigma_2 dz_2$$

$$\text{and } \sigma^2 = \sigma_1^2 + \sigma_2^2 + 2\sigma_1\sigma_2\rho_{12}$$

The parameter ρ_{12} denotes the coefficient of correlation between the commodity price in foreign currency and the exchange rate. It should be negative because an increase in the commodity price on the world market is generally believed to cause an appreciation of the exchange rate for the small commodity-exporting economy, and vice-versa. But the question whether σ^2 is less or higher than σ_1^2 to determine whether the commodity price in local currency is more volatile under the fixed regime or the

flexible regime will remain an empirical one since other shocks, namely the monetary shocks may be involved.

In any case the introduction of a flexible exchange rate to supplement the Stabilization Fund will be justified if this has the effect of increasing the drift term and/or reducing the variance of the return offered by the risky asset. To examine this question in the two-asset model, let us consider the case of a stationary process. The results obtained when the economy is assumed to have two categories of assets indicate that the value function as of time zero takes the following form as a function of w (from equation 60):

$$V(w, 0) = \frac{\phi}{2} \left[\delta - 2r + \frac{(\alpha - r)^2}{\sigma^2} \right] \left(-w + \frac{1}{r\phi} \right)^2 \quad (60)'$$

It appears clearly that the value function is a decreasing function of the variance σ^2 and an increasing function of the parameter α . Hence the following conclusion will apply: more uncertainty with regards the export receipts in domestic currency under the fixed exchange rate compared with the flexible exchange rate regime would mean a relatively lower satisfaction with the fixed rate regime, and conversely. Also, lower average of the export receipts in the domestic currency due for example to overvaluation would correspond to a net loss since exporters' income would limit significantly their level of consumption.

When we look at the solution G^* , we see that it is clearly an increasing function of the parameter α . But this solution G^* has the additional feature of involving the variance σ^2 in the two-asset model. As it can be seen from equation (61), the optimal

level of consumption is a decreasing function of σ^2 . The differential gives:

$$\frac{\partial G^*}{\partial \sigma^2} = \frac{(\alpha-r)^2}{\sigma^4} w - \frac{1}{r\phi} \frac{(\alpha-r)^2}{\sigma^4} \quad (61)'$$

or equivalently:

$$\frac{\partial G^*}{\partial \sigma^2} = \frac{(\alpha-r)^2}{\sigma^4} \left(w - \frac{1}{r\phi} \right) < 0$$

The differential is negative for the reason already given. More uncertainty in the export receipts under one exchange rate regime relatively to the other regime will affect adversely and directly the level of consumption. This relationship between G^* and σ^2 goes into line with the terms of comparison between the two regimes reached on the basis of the value function. However, the question arises of the situation where the external shocks and the performance of the flexible exchange rate policy combine to produce a higher value of α and σ^2 . Such a situation will not occur if the exchange rate policy is driven mainly by the formulation of an appropriate response to the external shocks. But suppose that the exchange rate is too volatile as a direct result of monetary shocks. Then the case may occur: a continued depreciation due to repeated money expansion would increase both α and σ^2 . Our results accommodate easily to handle this type of problem.

In the expression of $V(w, 0)$ and G^* , the parameters in question appear under the form of the ratio:

$$\frac{(\alpha-r)^2}{\sigma^2}$$

and one can see that both $V(w,0)$ and G^* are increasing with respect to this ratio. So when α and σ^2 change in the same direction due to the fact of introducing one of the two exchange rate regimes to replace the other one, we need only consider the resulting change in $(\alpha-r)^2/\sigma^2$ to be able to determine whether the country will be better off or not under the new exchange rate regime.

In the above example of monetary expansion, the economy will certainly witness a surge of inflation. The increase in α to reflect the increase in export receipts resulting from the depreciation of the currency does not necessarily mean that the purchasing power will boost for the exporters. Implicitly, we have taken α to correspond to the real purchasing power of the export receipts when one takes into account the domestic price change. An increase in α corresponds to the case where depreciation of the currency outweighs the increase in the domestic price.

Conclusion

The FZ countries as many other commodity-exporting countries have used national Stabilization Funds as a device to handle the fluctuations in the commodity price. The analysis bears first on the question raised by Hausmann, Powell & Rigobon (1993), whether or not one can justify the existence of a Stabilization Fund, particularly when the export receipts follow a non-stationary process. The setting uses a quadratic utility function

and a budget constraint which shows that the export receipts accruing to the Stabilization Fund will serve either to increase the stock of assets or for consumption.

The results of the analysis indicate that in the case where the instantaneous export receipts follow a non-stationary process in the short term but a stationary process in the long run, then a theoretical basis for the Stabilization can be established, thus extending the results obtained in the stationary case.

The optimization problem can be given a seemingly richer presentation which is the portfolio method. One considers two assets instead of one. In addition to the traditional risk-free (bond) asset, there is the risky asset. Every year the Stabilization Fund will have to decide the amount to save and also the allocation of this saving into the two alternative assets. This approach brings about the result that uncertainty will affect the decision : the optimal level of consumption will decrease as a function of the export receipts variance.

Secondly we consider the role of the Stabilization Fund in relation with the exchange rate regime. The question arises whether these two instruments, that is, the saving rule and the exchange rate rule combine each other or not for the task of stabilization. Introducing the saving rule is one feature extending the analysis presented in the previous chapters. A second feature of the extension relates to the form of the utility function which establishes a trade-off between the costs of inflation and the benefits of a higher output.

Considering the stationary case, one can see that the exchange rate will affect both the drift term and the variance

(uncertainty) of the export receipts. More importantly, the exchange rate will matter if the risk-free asset is set in local currency, and in this case it may contribute to dampen the effects of the commodity price shocks on the small economy. This is illustrated in the portfolio model by the fact that the optimal level of consumption interestingly appears as an increasing function of the ratio of the return differential between the risky asset and the risk-free asset, with respect to the level of uncertainty. Also, the share of the risky asset seems to decrease with the level of wealth.

Furthermore, the model can be used to look at the effects of export instability on savings and capital formation. The results obtained are compatible with the findings of the empirical literature on this issue.

Chapter 6: The overvaluation issue in the FZ

Introduction

The question whether the CFA currency was overvalued remained unsettled for a long time. More recently, Boughton (1991) found only three out of the thirteen member countries of the Zone, for which the currency showed a clear real appreciation³¹ during the period 1978-90. Nevertheless a big devaluation of 50 % occurred recently, in January 1994. In fact, the financial difficulties of the FZ countries offered no other alternative way but to devalue. So there was a real problem in the sense that on the one hand the general line, supported by a number of studies on the FZ such as Bhatia (1985), Guillaumont et al (1988), Medhora (1990) and Boughton (1991), did not point to the need for a devaluation and instead favoured to keep the statu-quo, and on the other hand the mounting difficulties in the Zone some observers attributed to an overvaluation of the CFA currency. One is certainly struck by the contrast between the view which was prevailing on the issue and the scale of the devaluation which occurred in the end.

In the present chapter, we suggest that the problem laid in part in the choice of the indicator upon which to assess the change in competitiveness of the Zone. We will look at a longer period as well, that is 1972-93.

³¹ The measure used in Boughton (1991) defines the real exchange as the effective exchange rate deflated by the ratio of the domestic and foreign price indices (CPI) while in most of this paper, the real exchange rate is defined as the ratio between the import goods price and the non-traded good price of the small economy, following the dependent economy model. Some scaling factor may link the two measures.

To organize the discussion, we use the framework of the theoretic-trade models in the form which allows the introduction of the monetary aspects to describe the adjustment process. The model provides a number of results in the light of which the behaviour of competitiveness in the FZ can be reassessed.

The first section presents a review of the literature. The second section presents the issue of the overvaluation and gives a detailed description of the model. It draws the distinction between the actual real exchange rate and the equilibrium real exchange rate. The third and last section compares the findings of the model with the experience of the FZ.

6.1. The theoretic -trade models: a review

This is a brief review of models which belong to the category of theoretic-trade models. They are used mostly to look at, in the context of a dependent economy, a vast range of issues, including stabilization programs, the deindustrialization problem or "Dutch disease". The review will start with the model of Salter (1959). The other papers to be covered include: Corden & Neary (1982), Neary and Wijnbergen (1986) and Lal (1989).

a. Salter (1959): "Internal and external balance: the role of price and expenditure effects".

By means of a simple diagram, the paper gives an analysis of how a small open economy may adjust back to equilibrium, following shocks such as: excess demand, rise in foreign prices or capital inflow. The analysis has come up with the conclusion that the adjustment process would normally combine a change in the

expenditure and a change in the relative prices.

As one of its most important features, the model draws a distinction between two categories of goods: the traded good the price of which is determined in the world market, out of control from the viewpoint of the small economy, and the non-traded good the price of which obeys to the balance between supply and demand on the home market. Aggregate output is taken as exogenous.

The traded good appears as a composite of exportables and importables and may be treated as such as long as the terms of trade are constant. This simplifies the analysis a great deal and brings the analysis down to a two-dimension basis: one traded good and one non-traded good. The equilibrium point on the diagram is depicted as the point of tangency between the transformation curve (supply side) and the indifference curve (demand side), where the slope of the tangent represents the relative price of the traded and the non-traded goods (initial equilibrium point A in fig 6.1a).

In dealing with the adjustment process³² and the change in the relative price, the model considers among other possibilities, the use of the exchange rate as a stabilization instrument. For example when the return to equilibrium calls for a decrease in the relative price of the non-traded good, the process may take

³² The adjustment process in the Salter and other theoretic-trade models involves what is known as the income and substitution effects or in the Dutch disease literature as the spending and resource-movement effects.

Fig 6.1b gives the representation of the departure from equilibrium after the adverse shock. There is a gap between the transformation curve and the indifference curve, reflecting the fact that the terms of trade decrease will affect more the producer's income than the consumer's demand. The move back to equilibrium will in general involve both a cut in expenditure and a modification of the relative prices.

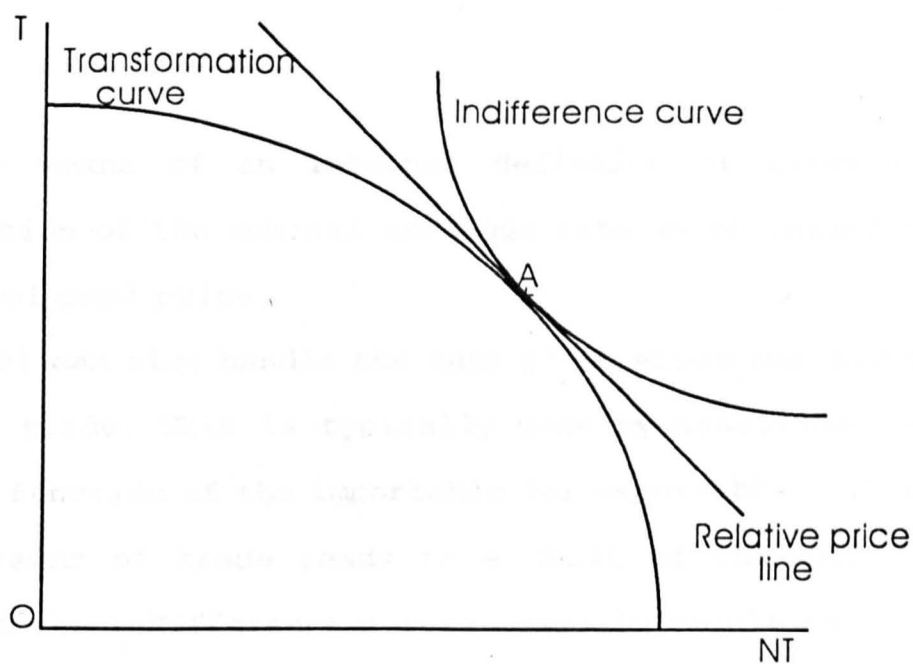


Fig6.1a: Equilibrium for the dependent economy

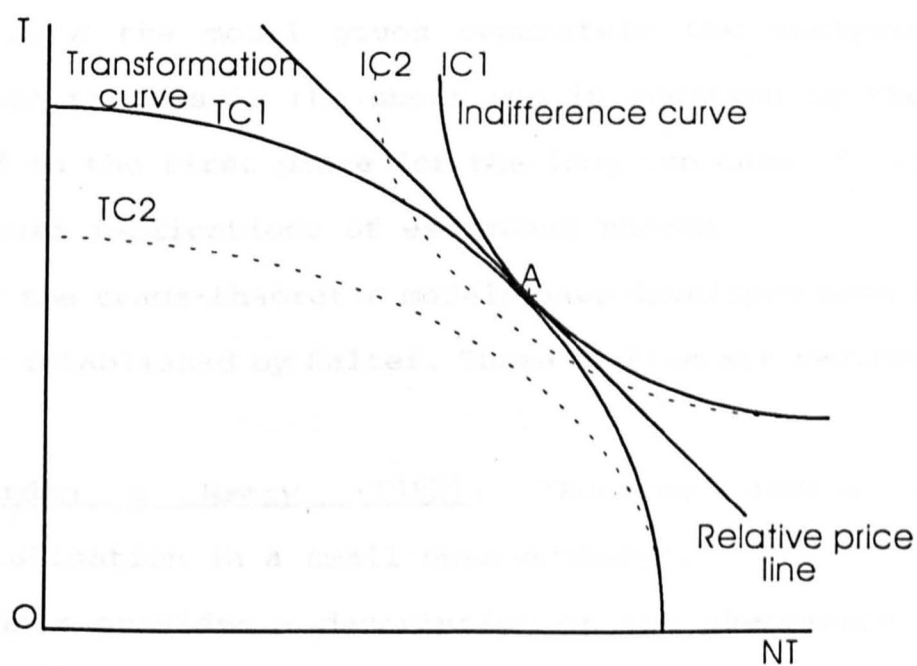


Fig6.1b: Departure from equilibrium an adverse terms of trade shock.

after

place by means of an internal deflation or alternatively a depreciation of the nominal exchange rate which causes a rise in the traded good price.

The model can also handle the case of an exogenous change in the terms of trade. This is typically done by measuring the traded goods in function of the importable (or exportable). Then a shock in the terms of trade leads to a shift of the transformation curve and the indifference curves, usually resulting in the same implications in terms of policy instruments required for a return back to equilibrium. Namely the combination of expenditure cut and price switching will enable the restoration of the internal and the external balance after, say a terms of trade decrease.

Furthermore the model gives separately the analysis of the adjustment process in the short run in addition to the results obtained in the first place for the long run case. It touches on the welfare implications of exogenous shocks.

Most of the trade-theoretic models have developed upon the basic model as established by Salter. Three of them are reviewed below.

b. Corden & Neary (1982): "Booming sector and de-industrialisation in a small open economy".

This paper provides a description of the phenomenon known as "Dutch Disease" whereby the tradeable sector is constituted of two sub-sectors, one booming for one reason or another and the second sub-sector declining as a consequence. One may think of the two sub-sectors as being the energy industry and the manufacture industry with the boom occurring in the energy industry.

The framework combines two diagrams describing the effect of the boom in the labour market and the product market respectively to explain the full extent of the induced de-industrialization. One of the diagrams is identical to the representation adopted by the Salter model. It derives the increase in the price the non-traded good. The other diagram uses the assumption of different factor intensities between sectors to demonstrate the decline in labour and level of activity in the manufacture sector. Indeed, the boom in the energy industry translates into an increase in the wage for the economy as a whole and this affects negatively the manufacture more than any other sector. We note that the non-traded sector may draw a positive effect (or a less negative one than for the manufacture sector) from the boom because its price increases in contrast with the manufacture price which is determined from the outside, by the world market conditions.

It is worth noting that the adjustment process leading to an unambiguous phenomenon of de-industrialisation happens in a context in which only labour is mobile between sectors while capital is sector-specific (short run). If one relaxes this assumption and allows capital mobility between two or more sectors (long run), then whether de-industrialisation occurs or not becomes an empirical question.

c. Neary & Wijnbergen (1986): "Natural resources and the macro-economy: a theoretical framework".

This paper attempts to outline the main features of the literature on the Dutch disease. It concerns the case of a resource discovery. But the framework is suitable to deal with

other situations of a boom in a specific sector or cases such as the terms of trade fluctuations. Later, we will consider more specifically the case of commodity price boom.

The deindustrialization and the real appreciation of the exchange rate which accompany a resource discovery constitute the focus of the paper. As in the previous models, the set-up represents a three-sector economy: the booming sector, the manufacturing sector and the non-traded good sector. The goods of the booming sector and the manufacturing sector are the tradeable goods. The strains on the manufacturing sector which cause the deindustrialization come from the increase in the wage on the labour market as a result of the boom.

(i) The model

To demonstrate this, the model considers two equations tracing the equilibrium on the non-traded good market and the labour market respectively:

$$x_n(q/w) = c_n(q, Y) \quad (1)$$

$$e_n(q/w) + e_m(w) + e_b(w, b) = L_0 \quad (2)$$

with the following notations:

q : the price of the non-traded good relative to the tradeable good (chosen as a numeraire). This is the inverse of the real exchange rate

w : the wage rate relative to the tradeable good

x_n : the supply of the non-traded sector which depends only on its price relative to the wage rate.

c_n : the demand for the non-traded good as a function of the non-traded good price and total income.

y_0 : the full-employment output

L_0 : the total labour force

e_n , e_m and e_b : the demands for labor by the three sectors

In equation (1), the total output y_0 would translate the impact of the boom by an exogenous increase. The demand for the non-traded good would rise in consequence. The price of the non-traded good will need to rise to bring the market back to equilibrium.

In equation (2), the parameter b in the labour demand of the booming sector represents the effect of the boom. When it occurs, the boom will increase the labor demand of the sector which most directly benefits from it. As the total labour force is given, this will bid up the wage rate until equilibrium is restored on the market.

Figure 6.2 gives in a (q, w) space the relative positions of the curve NN which represents the equilibrium on the non-traded good market and the curve LL which represents the equilibrium on the labour market.

Both lines are upward sloping as can be seen by considering the change required for the wage on the equilibrium line, following an increase in the price of the non-traded good. On the good market, the rise in q will cause a decrease in demand for, and an increase in the supply of, the non-traded good. The resulting excess supply corresponds to an excess demand on the labour market, which causes the wage rate to rise.

Also the slope of NN is higher than one since an increase in the

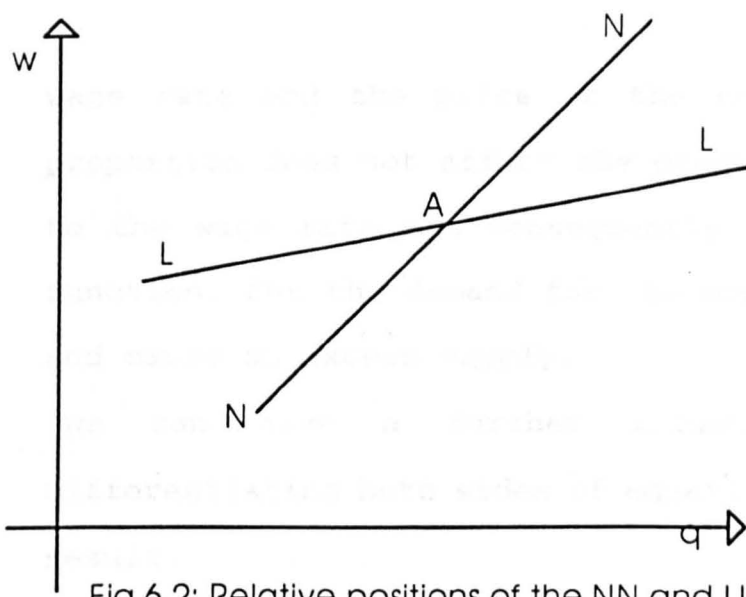


Fig 6.2: Relative positions of the NN and LL loci

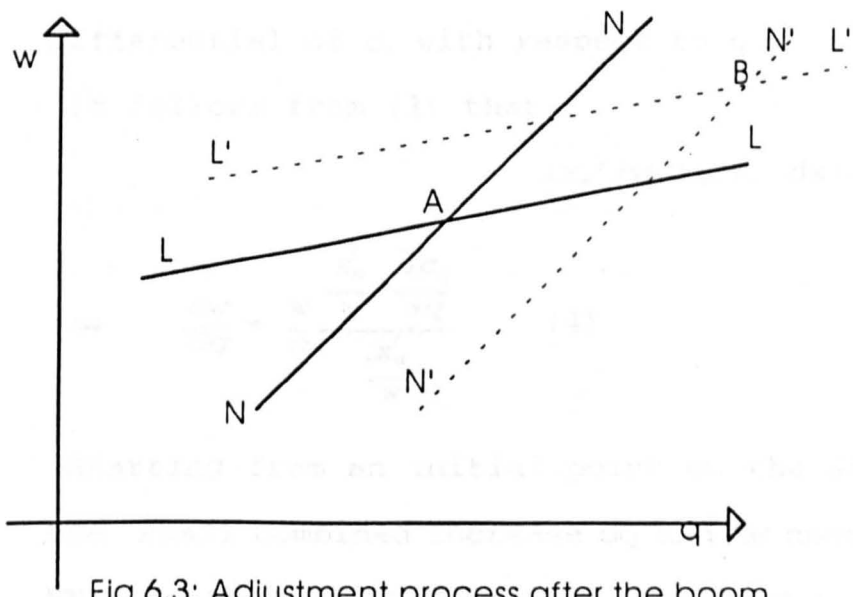


Fig 6.3: Adjustment process after the boom.

wage rate and the price of the non-traded good in the same proportion does not affect the price of the non-traded relative to the wage rate and consequently does not affect the supply function. But the demand for the non-traded good will decrease and cause an excess supply.

We can give a further illustration of this. Indeed, differentiating both sides of equation (1) will provide the same result.

$$x'_n(dq/w - qdw/w^2) = (\partial c_n/\partial q)dq \quad (3)$$

where x'_n denotes the differential of x_n and $\partial c_n/\partial q$ the partial differential of c_n with respect to q .

It follows from (3) that:

$$(x'_n/w)(q/w) dw/dq = x'_n/w - \partial c_n/\partial q$$

$$\Rightarrow \frac{dw}{dq} = \frac{w}{q} \frac{\frac{x'_n}{w} - \frac{\partial c_n}{\partial q}}{\frac{x'_n}{w}} \quad (4)$$

Starting from an initial point on the 45° line where $q/w = 1$, the small combined increase dq and dw necessary to remain on the NN line implies that $dw/dq > 1$ because $x'_n > 0$ and $\partial c_n/\partial q < 0$.

The same procedure can be applied to the line LL.

Differentiating equation (2) gives:

$$e'_n(dq/w - qdw/w^2) + e'_m dw + \partial e_p/\partial w \cdot dw = 0 \quad (5)$$

or equivalently:

$$(e'_n/w \cdot q/w - e'_m - \partial e_p/\partial w) dw/dq = e'_n/w \quad (6)$$

which leads to:

$$\frac{dw}{dq} = \frac{\frac{e'_n}{w}}{\frac{e'_n}{w} \frac{q}{w} - e'_m - \frac{\partial e_b}{\partial w}} \quad (7)$$

The signs of the differentials are straightforward:

$$e'_n > 0$$

$$e'_m > 0$$

$$\partial e_b / \partial w < 0$$

This implies that $dw/dq > 0$: upwards slope of the LL line. In addition, starting from a point on the 45° line we have $q/w = 1$ and the combined change dw and dq necessary to stay on the line of the labour market equilibrium are such that $dw/dq < 1$: the slope of the LL line is less than one.

(ii) Effect of the boom

Let us now consider the adjustment from the initial equilibrium to the new equilibrium following the boom. Representing the shock in the booming sector by db ($db > 0$), we analyze the overall effect on the wage rate after differentiating both equations, which gives:

$$e'_n (dq/w - qdw/w^2) + e'_m dw + \partial e_b / \partial b . db + e'_w dw = 0 \quad (8)$$

$$x'_n (dq/w - q/w^2 . dw) - \partial c_n / \partial q . dq - \partial x_n / \partial y . dy = 0 \quad (9)$$

Equation (9) gives:

Substituting (10) into (8), it follows:

$$dq = \left(\frac{x'_n q_0}{w_0^2} dw + \frac{\partial c_n}{\partial y} dy \right) \frac{1}{\frac{x'_n}{w_0} - \frac{\partial c_n}{\partial q}} \quad (10)$$

$$\frac{e'_n q_0}{w_0^2} \left(1 - \frac{\frac{x'_n}{w_0}}{\frac{x'_n}{w_0} - \frac{\partial c_n}{\partial q}} \right) dw = \frac{\partial e_b}{\partial b} db + \frac{e'_n}{w_0} \frac{\partial c_n}{\partial y} dy \frac{1}{\frac{x'_n}{w_0} - \frac{\partial c_n}{\partial q}} \quad (11)$$

The terms on the right hand side of (11) as well as the coefficient of dw are positive on the basis of the signs we can easily assign to the differentials.

It appears therefore that the boom will result in a rise in the wage rate as measured by equation (11). This can be given the graphical illustration as in the paper under review. Figure 6.3 represents the adjustment process implied by the boom shock.

The boom has the effect of shifting the LL curve upwards and the NN curve rightwards. The equilibrium point moves from A to B, reflecting an increase in the wage rate and the price of the non-traded good.

The increase in the wage rate affects adversely the manufacturing sector and causes its shrinkage since the price of tradeables is fixed by assumption³³.

In parallel, the increase in the price of the non-traded good represents the real appreciation of the exchange rate which leads to the reallocation of resources between the sectors. But the adjustment process triggered by the boom is more completely described through the spending (or income) effect and the

³³ We assume a fixed rate regime to simplify.

resource-movement (or substitution) effect as described in chapter 4, the combination of which gives in particular the move from A to B in fig 5.3.

Let us note that Corden (1984) considers particular circumstances under which the de-industrialisation problem might be overcome and that is, the presence of an immigration flow. More specifically one may mention that in the area of UMOA in the FZ, an important labour movement had been observed from neighbouring countries like Burkina Faso. This supply of extra labor helps to satisfy the demand coming from the booming sector (coffee and cocoa plantations in Cote d'Ivoire) and to lessen the bidding up of prices.

The paper by Neary and Wijnbergen (1986) more interestingly for our purpose here introduces the monetary dimension. This specification which we consider later provides a framework which seems to give, with an adequate application, an account of the FZ economic situation during the two last decades, with particular attention to the recession these economies have been facing since 1987.

- d. Lal (1989): " A simple framework for analyzing various real aspects of stabilization and structural adjustment policies".

The framework is based on a trade-theoretic model with two goods--tradable and non-tradable-- and three factors although these are reduced to labour and capital by assuming away the intermediate inputs. Again, the traded good is defined as a composite of the exportable and importable goods.

The analysis of the real economy involves a set of three diagrams: the first one describes the product market while the two others relate to the factor market in the short run and long run respectively. The assumptions on factor allocation assign the export sector as the most labour-intensive and the importable sector as the most capital-intensive one, and classify the non-traded sector at the intermediate position.

In addition to the description of the real economy, the model has a second component in the form of a simple representation of the domestic banking system. With this set-up comes the consideration of the main policy features implied by the stabilization and structural adjustment packages. They include the reduction or removal of product market distortions such as a tariff , dis-absorption via a reduction of the Government deficit or bank lending, and adjustment of a "repressed" financial market such as the ending of an interest rate ceiling.

A removal or reduction of a tariff is shown to lead in the long run to a real depreciation if the most labour-intensive sector is the export sector and to a real appreciation if it is the non-traded sector instead, and an increase of real wages. This represents the main result of the paper as the effect of a change in the tariff is traditionally presented in the literature as an empirical question. A reallocation of resources will occur from the tradable sector to the non-tradable sector , following the fall in the market price in the former. It will result in a change in the factor prices, namely at the expense of capital which the importables are most intensive in, and in favour of labour which the other sectors are more intensive in. The shift

of capital implied in the process will happen more easily if the distortions in the financial market are corrected so that to meet the need for enough loanable funds and new investment.

As we can see, the argument has gone much along the lines of the Stolper-Samuelson-Rybczynski result in the context of the theoretic-trade model.

e. Comparison with the BG model: Blundell-Wignall & Gregory (1990) "Exchange rate policy in advanced commodity-exporting countries: Australia and New-Zealand"

As seen in chapter 4 the BG model takes the form of a set of equations defining the equilibrium in the money market and the good market and specifying the determination of the price level dynamics. The economy produces two types of goods: the tradable as a composite of the exportable and importable and the non-tradable. There is no domestic production of the importable good which is only available through imports.

There are a number of similarities between the BG model and the models reviewed above. They all share the basic characteristics of the theoretic-trade model. In particular, the set of equations of the BG model corresponds to the diagram describing the product market in the other models.

However there seems to be a difference about the particular variables to focus on. Apart from the Salter model, the above models pay more attention to the factor market and aim at explaining what happens to the real wage in face of shocks. The terms of trade are assumed to remain constant. On this aspect, the paper by Salter goes further and in its part III, it

considers the effects of an exogenous change in the terms of trade. The depreciation of the nominal exchange rate viewed as a possible alternative to a pure deflation receives some attention, that is when the economy faces adverse terms of trade shocks and that the exchange rate is flexible.

But none of these papers directly addresses the issue on the choice of an exchange rate regime like the BG model which raises the case in consideration of two types of shocks, namely monetary and commodity price disturbances. However, Neary and Wijnbergen (1986) as already mentioned deal with the money market equilibrium and their model gives a presentation of the adjustment process under a flexible exchange rate and under a fixed rate regime, following a boom as the unique shock, and an illustration of the effect on the real exchange rate.

6.2. Theoretical account of the CFA overvaluation

a. The issue

Although the devaluation of the CFA has occurred only very recently, the controversy over whether it was overvalued can be traced back to at least ten years ago. In particular France had devalued its currency several times the mid-1980's and naturally more observers came to ask themselves what about the CFA currency itself. Sometimes, this question was raised in the context of the wider issue relating to the appropriateness of the exchange regime as it existed in the FZ. Some of the opinions which did not make the necessary distinction rendered the problem more complex. After all, the two aspects of the question (fixity of

the exchange rate and maintaining the FZ) do not bear the same political weight. The reason why the devaluation took so long to occur may be attributed in part to this sort of confusion. It holds true that there exists a possible line of argument for not drawing such a distinction. A devaluation raises expectations. One may therefore think that a devaluation of the CFA would lead the agents to speculate about the next devaluation and the process would thread to the question of the monetary system itself. For the proponents of the FZ, a devaluation certainly represents a risk.

On the other hand, maintaining the status-quo has its costs which became more and more apparent and the questions which arose were more difficult to put aside. The fact is that for two decades, the FZ confronted an international economic environment which required some readaptation and most countries around the world actually tried to adapt to it. The end of the fixed parities of the Bretton Woods in 1973 was a major event on the monetary front. In turn, it gave the way to very significant fluctuations between the key currencies. Most of the developing countries tried to cope with improved exchange rate systems (Aghevli & Montiel 1991). In addition to these movements between currencies, another dimension of the adverse external shocks came in with the terms of trade fluctuations. In this respect, the collapse of the commodity price on the world markets, specially from 1985 on appeared to represent a heavy burden which quickly accumulated to reach an unsustainable level.

Among the different reasons for the long delay in implementing the devaluation, we have chosen to develop the technical point

of view that the few studies such as Bhatia (1985) and Boughton (1991) did not find the need to devalue because of their instrument of measure. In the present case, the use of the actual real exchange rate as these studies did, is not enough to measure the misalignment (as indicated earlier on, these calculations use the ratios of domestic and foreign CPI's). The actual rate needs to be combined with the equilibrium real exchange rate to capture the problem the FZ was still facing at the end of 1993, before the devaluation in January 1994.

The interpretation of the real exchange rate has not always been easy. The case of Japan provides an example where you can have a real appreciation concomitant with trade surplus. The other case relates to Italy and Spain as discussed by Giovannini (1992), using the definition of the ratio between the tradable and non-tradable prices³⁴. Before we come to the model, let us add a point of illustration about the adverse shocks which affected the FZ countries and an indication of the disequilibrium which appeared during the period.

In a normal case, where the required adjustments occur without great lag, the actual real exchange rate presents itself as a good proxy for the measure of the competitiveness. This applies to developed and developing countries alike. However, the case of the FZ seems to be different in two respects at least. First, the fixed rate without any change in the parity for decades constitutes a unique case in itself. In face of the external

³⁴ In what follows, the real exchange rate, unless otherwise indicated, will be defined in the same way, that is, as the price of tradable goods preferably the import goods, relative to the price of the non-traded good.

shocks, a small open economy has usually two instruments it can combine for the purpose of stabilization: the nominal exchange rate appreciation or depreciation, specially if it is free to float, on the one hand and the internal deflation on the other hand.

The FZ countries tried to do with the second instrument only. But the internal deflation did not go far enough to correct the macroeconomic imbalances specially the current account deficits, or it was too painful to be fully operated given the scale of the shocks and their cumulative effect for a long time. None of these countries escaped an unprecedented wave of social unrest from the mid-1980's. The reduction in real income and the welfare loss as a result of the collapse in the commodity price as illustrated in chapter 1 have undoubtedly played an important role in the new situation. However beyond that direct effect, deep dis-equilibria seem to have set in. The FZ as a pool of exchange reserves and the guaranty of the CFA convertibility by France present a number of advantages for the member countries. But this appears more significantly only when the external shocks which affect these countries do not affect them at the same time and in the same direction for too long. What happened and intensified the problems of the FZ was instead the long-lasting low level of commodity prices. If we take the group of commodities which provide most of the exports in the FZ (cocoa, coffee, cotton, groundnut oil, phosphate and so on), their export price decreased significantly between 1980 and 1990, more than 50% for three of them, between 18% and 50% for four other commodities. The terms of trade give a more complete picture of these external shocks

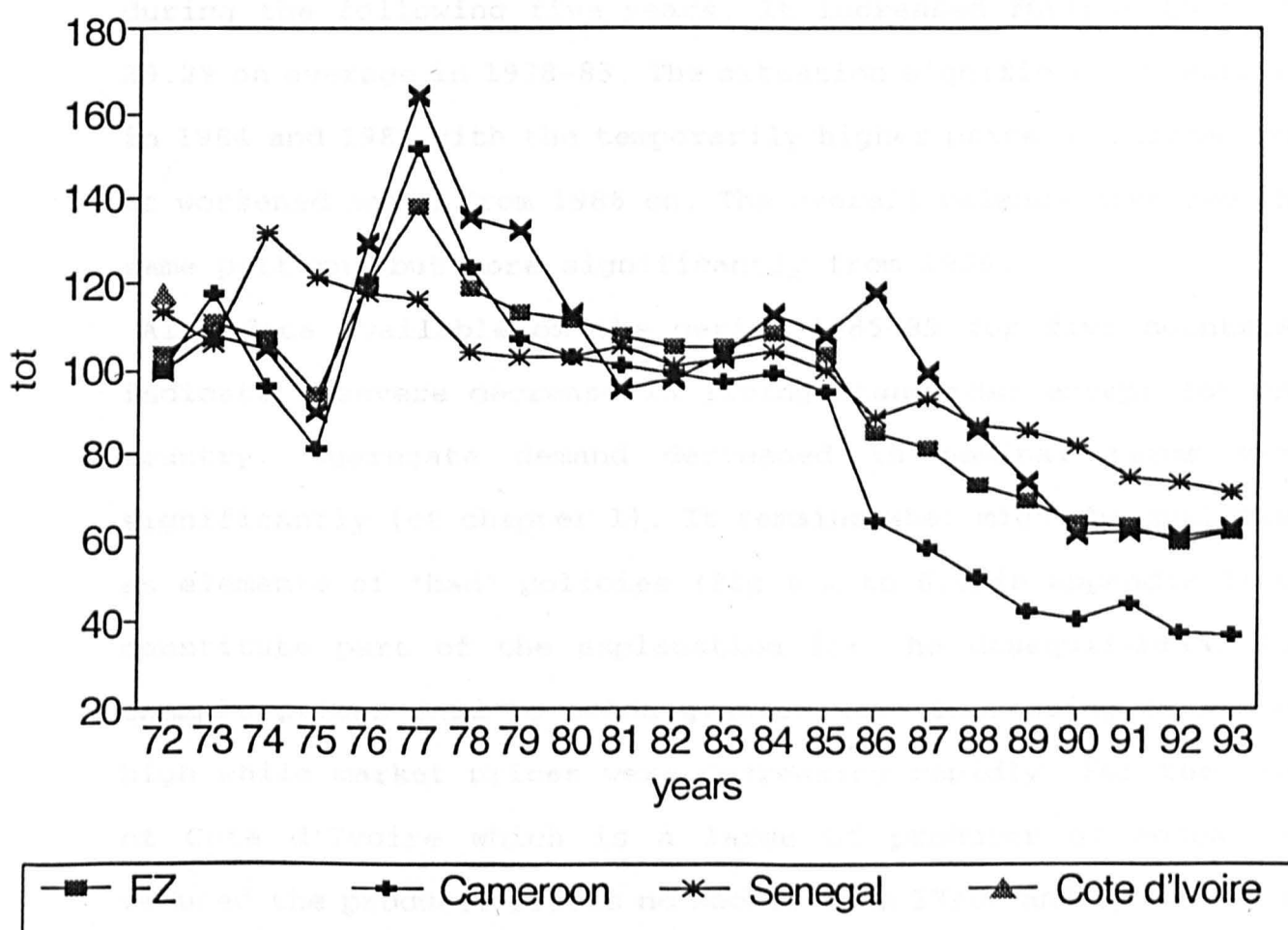
(fig 6.4): we can observe large variations and, a downward trend especially from 1978 on. The terms of trade index fell as low as 61.4 in 1993 compared with 118.7 in 1978. We recall that other shocks affected also the FZ countries as indicated in chapter 1 but the terms of trade fluctuations certainly represent the most significant category. The consequences were dire because for most of the FZ countries, the commodities concerned represent their main sector of production and the bulk of their exports.

Belonging to the FZ has presented the member countries with no alternative but to deflate (or it seemed so) and at the same time it enabled most of them to delay the necessary adjustment. These circumstances have favoured the mounting balance of payment deficits.

Our argument is that in this kind of disequilibrium, the actual real exchange rate does not reflect well enough the level of competitiveness required by the economy. In other words, it is not a surprise that most of the studies or discussions based on this indicator (the actual real exchange rate) proved at best inconclusive about the overvaluation of the CFA currency.

At the same time, any observer of the FZ economies for a decade or so could not do without noting the huge Government deficits and balance of payments deficits, in particular for the largest economies of the Zone and for the Zone as a whole. Mussa (1986) has identified two main ways in which economic policies affect the real exchange rate: exogenous shifts in the form for example of change in the composition of the excess demand between the traded and non-traded goods on the one hand and on the other the absorption gap. The latter seems to have been a very

Fig 6.4: TOT 1972-92



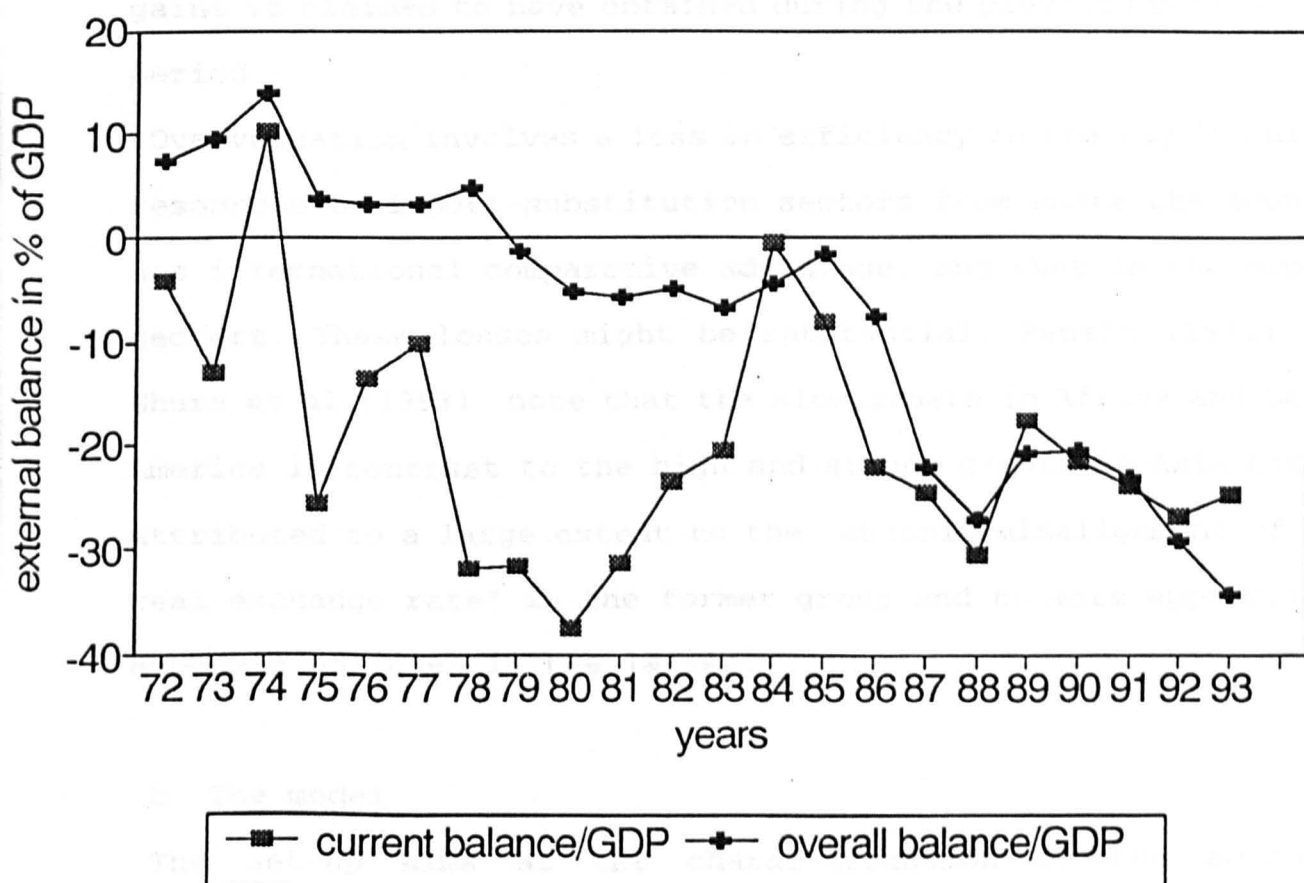
Source : Devarajan et al (1991), and World Economics Outlook (IMF)

characteristic feature of the FZ, specifically through the overspending of Government budget. With the fall in the terms of trade, also the external disequilibria became more and more acute in the area, and to some extent one needs only to look at these disequilibria (fig 6.5) to illustrate that there was a problem with the unchanged CFA parity. The current account deficit³⁵ in percent of GDP increased from 4.2% in 1972 to an average of 14.5% during the following five years. It increased further to reach 29.2% on average in 1978-83. The situation significantly improved in 1984 and 1985 with the temporarily higher price of coffee, but it worsened again from 1986 on. The overall balance mirrored the same pattern, but more significantly from 1986.

Also data available on the period 1985-89 for five countries indicate a severe decrease in living standards; except for one country, aggregate demand decreased in nominal terms very significantly (cf chapter 1). It remains what might be qualified as elements of "bad" policies (fig 6.a to 6.d in appendix 2) to constitute part of the explanation for the disequilibria: for example prices paid to cocoa growers were increasing or stayed high while market prices were decreasing rapidly. For the case of Cote d'Ivoire which is a large producer of cocoa, it reduced the producer prices no sooner than 1990, and by that time the world prices were half their level in 1985 when a steady decrease started. Still the reduction in the producer price when it occurred and although important (50%) proved insufficient to tackle the disequilibria. These dis-equilibria had become

³⁵ These figures follow the definition in IFS which does not incorporate the exceptional financing. The latter became more and more substantial.

**Fig 6.5: External balance in
the african FZ countries**



Source : IFS and World Economic Outlook, IMF

unsustainable and eventually the devaluation occurred because unavoidable. With the benefit of hindsight, it appears as a desperate reaction to a desperate situation. Whatever the aftermath of this event, one has the feeling that a chance has been missed to conduct an appropriate monetary policy to minimize the difficulties which arose with the sharp decline in the terms of trade, the adverse effect of the external shocks in general, and that the Zone has lost in the process a great deal of the gains it claimed to have obtained during the previous more stable period.

Overvaluation involves a loss in efficiency in the way it shifts resources to import-substitution sectors from where the economy has international comparative advantage, and that is the export sectors. These losses might be substantial. Renelt (1991) and Ghura et al (1993) note that the slow growth in Africa and Latin America in contrast to the high and steady growth in Asia can be attributed to a large extent to the "chronic misalignment of the real exchange rate" in the former group and to more appropriate economic policies in the latter.

b. The model

The set-up aims at the characterization of the economic situation of the FZ economies in the face of external shocks. We consider a two-sector economy which has, like in the traditional dependent economy model, a non-traded good and a traded good. The latter is a composite of the export good which is a commodity, and the importable good. The prices of the non-traded good and of the exportable good are defined relative to the price of the

importable. In the same way, the real exchange rate will be defined as the relative price of the import good compared with the price of the non-traded good. Consequently, considering that the foreign price of the import good is given, the real exchange rate will equal the ratio of the nominal exchange rate with respect to the price of the non-traded good.

Until further notice, we assume that the monetary authorities have adopted a flexible exchange rate regime.

The model itself is a modified version of the model used by Neary & Wijnbergen (1986) and which introduces the monetary aspects in the Dutch disease analysis.

The modifications concern:

- the nature of the boom which takes the form of a terms of trade increase. Our specification considers also the reverse case of a bust in the terms of trade.
- the output level is made endogenous. It will depend on the terms of trade index and on the level of competitiveness.

The following four equations give the representation:

$$M/P = ky \quad (12)$$

$$Y = Y(p_x^*, S/p_n) \quad (13)$$

$$P = P(p_n, S) \quad (14)$$

$$Y_n(p_n/S, p_x^*) = d_n(p_n/S, Y, M/P) \quad (15)$$

The notations are very similar to those of chapter 4 with:

M: money supply

S: nominal exchange rate

P: domestic price index

p_n : nominal price of the non-traded good

y : aggregate output

y_n : supply of the non-traded sector

d_n : demand for the non-traded good

p_x^* : commodity price in foreign currency or terms of trade

The parameter k is positive and denotes the velocity of money. The money supply will be exogenous under a flexible exchange rate regime so that the system of 4 equations will determine simultaneously the unknown variables y , y_n , p_n and S . This representation is simplified to leave out the explicit mention that the tradable sector consists of two goods: the commodity good and the other tradable good. We assume in this context that the domestic supply of the tradable sector is limited to the production of the commodity good and the economy will resort to imports for the consumption needs for the other tradable good. All the prices will be expressed relative to the price of imports in domestic currency³⁶. Under a fixed rate regime, S becomes exogenous and M endogenous.

The representation is quite standard. Equation (12) represents the money market equilibrium and equation (15) the equilibrium on the non-traded good market. Equations (13) and (14) define the variables y and P and their substitution into (12) and (15) define a space (p_n, S) which will serve for our graphic representation. Equation (13) represents the demand curve.

We will give a representation of the economy in a (S, p_n) space.

³⁶ In this context, one may have implicitly: $p_m y = p_n y_n + p_x y_x$ where y_x and p_x denote the supply and the price in domestic currency of the commodity while p_m represents the price of imports in domestic currency.

To prepare the construction of the diagram, we start by determining the slopes of the curves representing the equilibrium on each market. We look at the small changes in p_n and S compatible with remaining on the money market equilibrium.

Differentiating (12) gives:

$$-M/P^2 \cdot dP = k dy \quad (16)$$

or equivalently:

$$-\frac{M}{P^2} \left(\frac{\partial P}{\partial p_n} dp_n + \frac{\partial P}{\partial S} dS \right) = k \frac{\partial y}{\partial c} \left(\frac{dS}{P_n} - \frac{S}{P_n^2} dp_n \right) \quad (17)$$

where the notation $c \equiv S/p_n$ is used for the competitiveness indicator. Equation (17) can be rewritten as follows:

$$\left(k \frac{\partial y}{\partial c} \frac{S}{P_n^2} - \frac{M}{P^2} \frac{\partial P}{\partial p_n} \right) dp_n = \left(k \frac{\partial y}{\partial c} \frac{1}{P_n} + \frac{M}{P^2} \frac{\partial P}{\partial S} \right) dS \quad (18)$$

The ratio between the coefficient of dS and dp_n in (18) defines the slope of what will be the money market equilibrium curve. One can easily see that the coefficient of dS has a positive sign. By contrast, the coefficient of dp_n does not have a definite sign: it might be positive or negative, which means that the curve corresponding to the money market equilibrium might be upward sloping or downward sloping. The latter case is more likely the more there is monetary illusion so that the domestic price index is mainly determined by the price of the non-traded good and also the less sensitive output is with respect to the level of competitiveness.

One can see from equations (12) and (13) that an increase in the exchange rate would increase the level of output and consequently the level of demand for real balances. It would also increase the

price index and reduce the stock of money in real terms. An excess demand for money would result. This clear-cut effect of a rise in the traded good price is in contrast with the case of a change in the price of the non-traded good, which explains the fact that the sign of the coefficient of dp_n is not determinate. Indeed an increase in p_n would reduce the level of output and demand for real balances. It would also increase the price index and result in a reduction in the stock of the real balances. Whether there will be an excess demand or an excess supply of real balances will depend on which of these two effects will predominate.

We proceed similarly with the equilibrium equation on the market of the non-traded good. Differentiating equation (15) gives:

$$\frac{\partial Y_n}{\partial c} \left(\frac{dS}{p_n} - \frac{S}{p_n^2} dp_n \right) = \frac{\partial d_n}{\partial c} \left(\frac{dS}{p_n} - \frac{S}{p_n^2} dp_n \right) + \frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial c} \left(\frac{dS}{p_n} - \frac{S}{p_n^2} dp_n \right) - \frac{M}{P^2} \frac{\partial d_n}{\partial m} dP \quad (19)$$

where $\partial Y_n / \partial c < 0$ and $\partial d_n / \partial c > 0$, and the notation m represents the real balances M/P .

Since $dP = \partial P / \partial p_n \cdot dp_n + \partial P / \partial S \cdot dS$, we can rewrite (19) as follows:

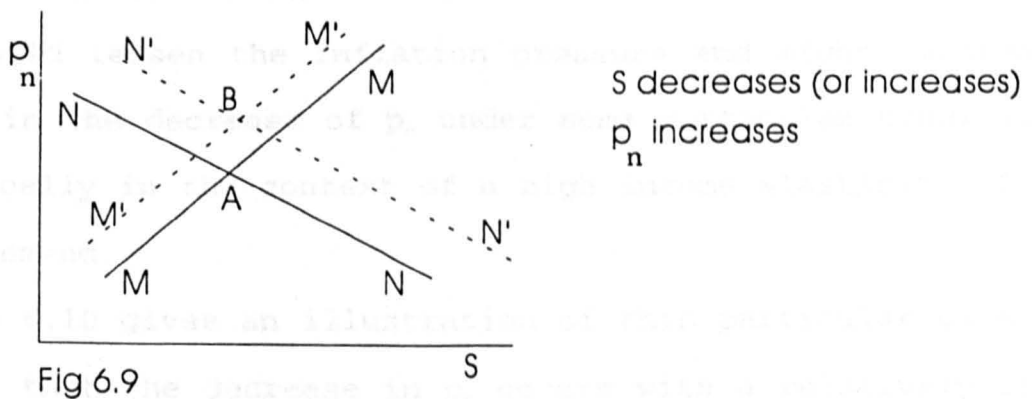
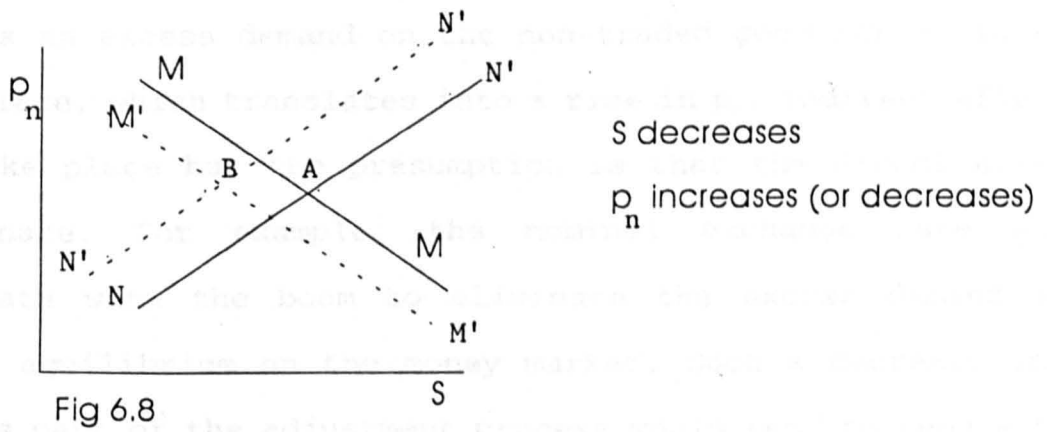
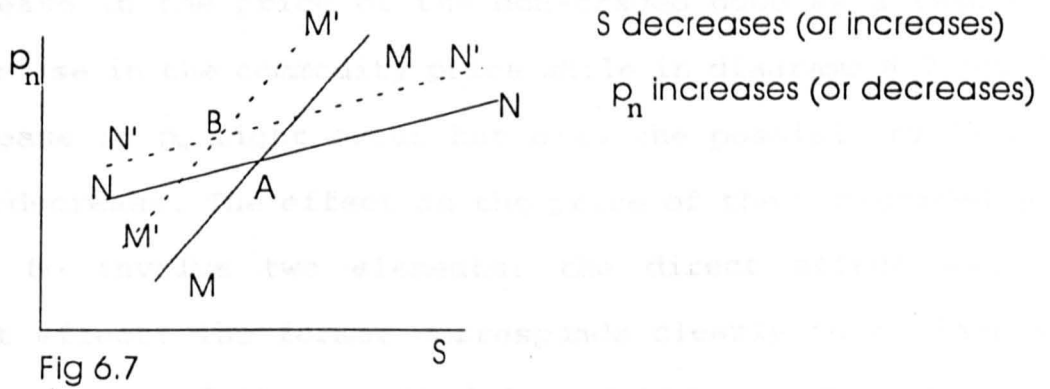
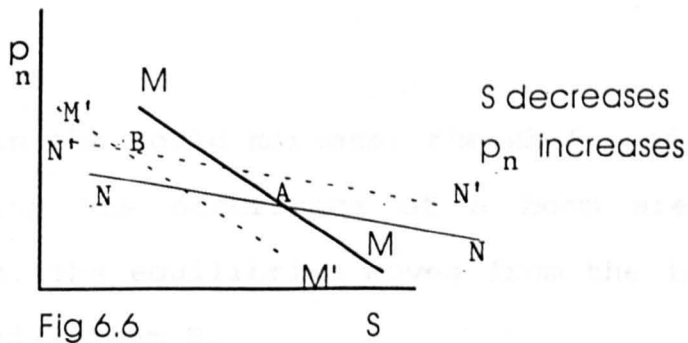
$$\begin{aligned} \left[\left(\frac{\partial d_n}{\partial c} - \frac{\partial Y_n}{\partial c} \right) \frac{S}{p_n^2} + \frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial c} \frac{S}{p_n^2} + \frac{M}{P^2} \frac{\partial d_n}{\partial m} \frac{\partial P}{\partial p_n} \right] dp_n = & \left[\left(\frac{\partial d_n}{\partial c} - \frac{\partial Y_n}{\partial c} \right) \frac{1}{p_n} \right. \\ & \left. + \frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial c} \frac{1}{p_n} - \frac{M}{P^2} \frac{\partial d_n}{\partial m} \frac{\partial P}{\partial S} \right] dS \quad (20) \end{aligned}$$

The coefficient of dp_n in equation (20) is determinate and is positive while the sign of the other coefficient might be positive or negative. The former case is more likely in the context of monetary illusion so that the term $\partial P/\partial S$ would be negligible. The effect of an initial increase in the exchange rate or the price of the non-traded good on the equilibrium of the non-traded good can be seen along similar lines as for the money market. One obtains the same results but the roles of p_n and S are reversed.

The different possible configurations depending on the signs of the coefficients in equations (18) and (20) are represented in diagrams 6.6 to 6.9. Let us note that the case treated in Neary & Wijnbergen (1986) corresponds to diagram 6.8. We can also note that the MM curves always have a slope higher than one while the NN curves have a slope lower than one. This can be seen by looking at the coefficients of dp_n and dS in equations (18) and (20) respectively.

What sense to give to these different configurations? They might not be equally likely. The price and income sensitivity of the demand and supply functions on the goods market as well as the income elasticity on the money market will be a determinant factor. Also the weights given to the non-traded good price and the traded good price respectively in the composition of the domestic price index (equation 14), and the elasticities of the aggregate output (equation 13) should be taken into account.

We have indicated the effects of an increase in the commodity



price in the world markets: the shifts of the MM and NN curves following the occurrence of a boom are indicated for each diagram. The equilibrium moves from the initial point A to the new equilibrium B.

In diagrams 6.8 and 6.9, the shift of the equilibrium indicates an increase in the price of the non-traded good as a result of the increase in the commodity price while in diagrams 6.7 and 6.8 an increase in p_n might occur but also the possibility is open for its decrease. The effect on the price of the non-traded good appears to involve two elements: the direct effect and the indirect effect. The former corresponds clearly to an increase in the price p_n of the non-traded good because the rise in p_x^* provokes an excess demand on the non-traded good market in the first place, which translates into a rise in p_n . Indirect effects will take place but the presumption is that the direct effect predominate. For example, the nominal exchange rate will appreciate with the boom to eliminate the excess demand and restore equilibrium on the money market. Such a decrease in S which is part of the adjustment process would tend to reduce the excess demand on the market of the non-traded good. Consequently, this would lessen the inflation pressure and might eventually result in the decrease of p_n under some particular conditions, specifically in the context of a high income elasticity of the money demand.

Figure 6.10 gives an illustration of this particular case. It appears that the decrease in p_n occurs with a relatively large shift of the MM locus reflecting an important liquidity effect (which is associated with a high income elasticity of the demand

for money) combined with a relatively small shift in the NN curve. The move of the NN locus in fig 6.10 would correspond to a situation of an economy where the supply of the non-traded sector is not very sensitive to the change in the price of the commodity sector so that the excess demand for the non-traded good following a boom in the export sector would prove little significant.

Another factor which can explain the rather small size of the excess demand relates to the response of the demand for the non-traded good itself. Equation (15) shows this demand as a function of income. But the effect of the commodity price on income has two aspects: the direct effect does increase income. This is the spending effect of the boom since the terms of trade improve and consequently the real income rises. However, the indirect effect works in the reverse sense and will tend to dampen this increase in real income because the appreciation of the currency as a result of the boom will reduce the degree of competitiveness and the level of income. If the indirect effect proves relatively important, then the demand for the non-traded good would not increase very much when the boom occurs.

We see that fig 6.10 describes the case of an economy where the boom provokes a large liquidity effect. Under the assumption that the money supply is given, this liquidity effect will put a strong downward pressure on the domestic price for the real balances to increase and restore the equilibrium on the money market. A significant decrease in the nominal exchange rate will follow as can be seen in diagram 6.10. But this may not be sufficient. The liquidity effect may spill over and affect also

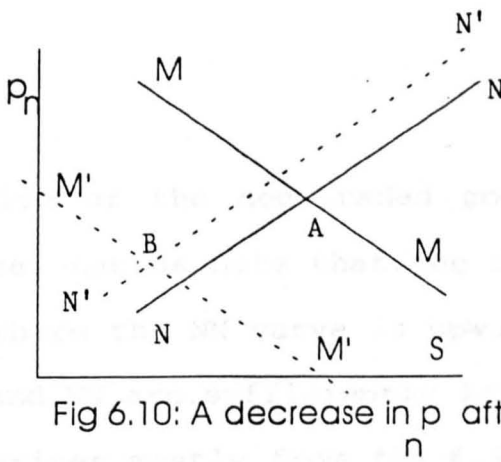


Fig 6.10: A decrease in p after the boom.

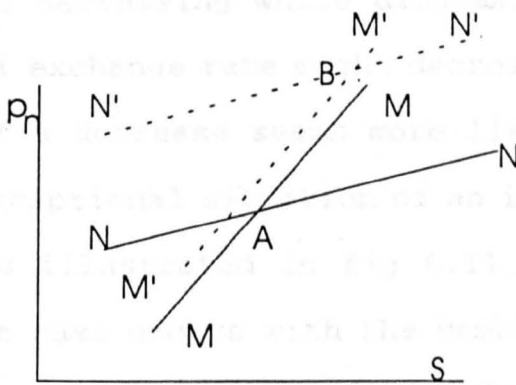


Fig 6.11: An increase in S after the boom.

A FEW PARTICULAR CASES

the price of the non-traded good, leading ultimately to its decrease. Let us note that the decrease in p_n may occur in the cases where the NN curve is upward sloping provided the shift of MM and NN are sufficiently large and small respectively. Fig 6.10 derives mostly from fig 6.6 but a similar extension might be obtained from fig 6.7 as well.

With regards the nominal exchange rate, diagrams 6.6 and 6.8 show it decreasing while diagrams 6.7 and 6.9 suggest that the nominal exchange rate might decrease or increase, even though the case of a decrease seems more likely.

The exceptional situation of an increase in the nominal exchange rate is illustrated in fig 6.11. In contrast to fig 6.10, the present case occurs with the combination of a large shift in the NN locus and a small shift in the MM locus, that is a situation where the boom causes a large excess demand on the market of the non-traded good while the liquidity effect is relatively small, leading to a depreciation of the nominal exchange rate. In fact, the possibility of this case occurring is open as long as the MM curve is upward sloping and provided the shift in NN and MM are large and small enough respectively as described above. Fig 6.11 corresponds to an extension of fig 6.7 but a similar illustration can be derived as well from fig 6.9 where the MM curve is upward sloping but the NN curve is downward sloping in contrast to fig 6.7.

We recall from equation (18) that the condition of an upward sloping MM locus goes along the following terms:

- a non-existence of monetary illusion and an important tradeable sector so that the domestic price index represents to a large

extent a reflection of the foreign price index.

c. Effect of a boom: a further illustration

We are going to indicate some calculations to measure the overall effect of a boom on the price of the non-traded good and on the nominal exchange rate.

We first give the extensions of equations (18) and (20) with the incorporation of the change in the commodity price which occurs in the first place and which leads to the shift of the equilibrium to a new position. The corresponding changes in p_n and S are determined below.

The extension of equation (18) and (20) can be written as follows:

$$A dp_n = B dS + k \frac{\partial Y}{\partial p_x^*} \cdot dp_x^* \quad (21)$$

$$C dp_n + \frac{\partial Y_n}{\partial p_x^*} \cdot dp_x^* = D dS + \frac{\partial d_n}{\partial Y} \cdot \frac{\partial Y}{\partial p_x^*} \cdot dp_x^* \quad (22)$$

where the following notations have been introduced:

$$A = k \frac{\partial Y}{\partial C} \frac{S}{p_n^2} - \frac{M}{P^2} \frac{\partial P}{\partial p_n}$$

$$B = k \frac{\partial Y}{\partial C} \frac{1}{p_n} + \frac{M}{P^2} \frac{\partial P}{\partial S}$$

$$C = \left(\frac{\partial d_n}{\partial C} - \frac{\partial Y_n}{\partial C} \right) \frac{S}{p_n^2} + \frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial C} \frac{S}{p_n^2} + \frac{M}{P^2} \frac{\partial d_n}{\partial m} \frac{\partial P}{\partial p_n}$$

$$D = \left(\frac{\partial d_n}{\partial c} - \frac{\partial y_n}{\partial c} \right) \frac{1}{p_n} + \frac{\partial d_n}{\partial y} \frac{\partial y}{\partial c} \frac{1}{p_n} - \frac{M}{P^2} \frac{\partial d_n}{\partial m} \frac{\partial P}{\partial S}$$

The coefficients B and C are definitely positive while the coefficients A and D might be positive or negative as already mentioned. In addition, the following relationships should hold true at least near the 45° degree line:

$$A < B$$

$$D < C$$

After substitution from equations (21) and (22), we can derive the expressions of dS and dp_n in function of the boom indicator dp_x^{*}:

$$dS = \frac{A}{BC-AD} \left(\frac{\partial d_n}{\partial y} \frac{\partial y}{\partial p_x^*} - \frac{\partial y_n}{\partial p_x^*} - \frac{Ck}{A} \frac{\partial y}{\partial p_x^*} \right) dp_x^* \quad (23)$$

$$dp_n = \left[\frac{B}{BC-AD} \left(\frac{\partial d_n}{\partial y} \frac{\partial y}{\partial p_x^*} - \frac{\partial y_n}{\partial p_x^*} - \frac{Ck}{A} \frac{\partial y}{\partial p_x^*} \right) + \frac{k}{A} \frac{\partial y}{\partial p_x^*} \right] dp_x^* \quad (24)$$

It appears in equation (23) that if the coefficient A is negative, that is, if the MM curve is downward sloping as in fig 6.6 and 6.8, then the nominal exchange rate will decrease (dS < 0) following a boom. This confirms elements of the discussion above. If conversely A is positive, then the sign of dS will depend on the value of the term k/A · ∂y/∂p_x^{*} compared with the other terms between brackets of equation (23). If the term in question is not large enough, then we have dS > 0, and this corresponds to the illustration of diagram 6.11. Otherwise we have the case of diagrams 6.7 and 6.9 where a decrease in S is observed.

With regards the price of the non-traded good, we can rewrite equation (24) as follows:

$$dp_n = \frac{B}{BC-AD} \left(\frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial p_x^*} - \frac{\partial y_n}{\partial p_x^*} \right) dp_x^* + \left(1 - \frac{BC}{BC-AD} \right) \frac{k}{A} \frac{\partial Y}{\partial p_x^*} dp_x^* \quad (25)$$

or equivalently:

$$dp_n = \frac{B}{BC-AD} \left(\frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial p_x^*} - \frac{\partial y_n}{\partial p_x^*} \right) dp_x^* - \frac{Dk}{BC-AD} \frac{\partial Y}{\partial p_x^*} dp_x^* \quad (26)$$

The first term on the right hand side of equation (26) is definitely positive. The sign of the second term and by extension the sign of dp_n will depend on the sign of D . If D is negative, then we obtain:

$$dp_n > 0$$

This means wherever the NN locus is downward sloping ($D < 0$), equation (26) ensures that the boom will result in an increase in the price of the non-traded good. This case is portrayed in diagrams 6.8 and 6.9.

Conversely, if D is positive instead, the possibility of a negative sign of dp_n following the boom cannot be excluded. This corresponds to what has been said about the diagrams 6.6 and 6.7.

d. A real appreciation

The analysis of the previous subsection has dealt with the change in p_n or S taken separately. The analysis has outlined the circumstances under which one might observe an increase or decrease in these two variables. A question remains to be answered however, and that is what happens to the real exchange

rate (RER). The different configurations reviewed above all suggest that a real appreciation will result from the boom in the commodity sector. One has an indication of that by comparing the relative positions of the ray through the origin to the initial equilibrium which represents the initial value of the real exchange rate on the one hand and the second ray through the origin to the new equilibrium point which represents the new real exchange rate on the other hand.

To determine the change in the real exchange rate, we start by rewriting equation (23) as follows:

$$dS = \frac{A}{BC-AD} \left(\frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial p_x^*} - \frac{\partial Y_n}{\partial p_x^*} \right) dp_x^* - \frac{Ck}{BC-AD} \frac{\partial Y}{\partial p_x^*} dp_x^* \quad (27)$$

We define the real exchange rate like in the dependent economy model, as the ratio between the price of the tradable and the price of the domestic non-traded good. This emphasizes the substitution mechanism between the tradable and the non-tradable sectors and its effect on the behaviour of the current account.

Subtracting equation (26) from equation (27), one obtains:

$$dRER \equiv \frac{S}{P_n} \left(\frac{dS}{S} - \frac{dp_n}{P_n} \right) = - \frac{BS - Ap_n}{(BC-AD)P_n^2} \left(\frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial p_x^*} - \frac{\partial Y_n}{\partial p_x^*} \right) dp_x^* - \frac{Cp_n - DS}{(BC-AD)P_n^2} k \frac{\partial Y}{\partial p_x^*} dp_x^*$$

Since $A-B > 0$ and $C-D > 0$ as indicated above, equation (28) shows that the change in the real exchange rate is a decrease or in other words a real appreciation. This is in accordance with the result obtained by the BG model (chap 4) that an increase in the terms of trade causes a real appreciation of the exchange

rate.

The result applies to the different configurations of fig 6.6 to 6.11, despite their diversity. Conversely, a decrease in the commodity price will lead to a real depreciation. We discussed particular circumstances under which a rise in the nominal exchange rate or a decrease in the price of the non-traded good might occur. Therefore it is clear that the real appreciation for example should not be equated to a nominal appreciation and/or an increase in p_n , even though these cases are more likely than the others. What equation (28) ensures is that on the occasion of a boom, an increase if any in S will be more than matched by an increase in p_n and conversely a decrease in p_n will be more than matched by a decrease in S so that eventually we will obtain a real appreciation of the exchange rate.

e. Comparison between exchange rate regimes

The economic difficulties, notably the unprecedented financial dis-equilibria the FZ economies faced during the last decade might be avoided if the peg to the French Franc (FF) had not remained unchanged despite repeated external shocks. As far as the external shocks are concerned in contrast to the monetary shocks, a flexible exchange rate presents some advantages vis a vis a fixed rate regime.

This implies that in the case of the FZ, at least a change in the parity of the CFA parity should have happened a long time ago. The reasons why it happened so late are still being discussed and may still concern some observers for a time to come.

In the present sub-section, we illustrate the advantages of a flexible exchange rate for a small economy subject to terms of trade shocks and we draw a distinction between the actual real exchange rate and the equilibrium real exchange rate. The difference between the two rates seems to have been substantial for the FZ economies. Our belief is that this distinction was necessary in order to grasp the extent of the overvaluation of the CFA. We start by a look at the inflation concern and the availability of adjustment tools.

(i) The inflation pressure

We use a configuration similar to fig 6.8 for further discussion of the adjustment process. Another configuration might be chosen. But the fact that fig 6.8 is the most likely justifies our choice. Also, as long as the real exchange rate is concerned, the selection of one particular configuration does not matter. Indeed, the real exchange rate changes in the same direction in each case, following the occurrence of an external shock. We consider therefore diagram 6.12 which is derived from fig 6.8. The boom shifts the line MM of the money market equilibrium to $M'M'$ and the line NN of the non-traded good market equilibrium to $N'N'$, under the assumption of a freely flexible exchange rate. The new equilibrium is therefore located at B. At the new position, the price of the non-traded good has increased from p_{n0} to p_{nb} while the nominal exchange rate has decreased from S_0 to S_b . The real exchange rate which was represented by the ray OA now equals the value corresponding to the ray OB.

We can see on fig 6.12 that the increase in p_n becomes much more

important under a fixed rate regime³⁷. The fixed rate regime means that the money supply becomes endogenous and the boom will shift the MM locus to a new position above the point A. The equilibrium under the flexible regime moves from A to C in the short run. But in the long run, the real exchange rate under the fixed rate regime should equal its value under the flexible rate. This is to say that the monetary variables do not enter the determination of the long run real exchange rate (Edwards 1989a, Neary et al 1986). The equilibrium will move from C to D on the ray OB so that the real exchange rate does not depend on the exchange regime adopted but only on the real shocks of the terms of trade. Consequently, the price of the non-traded good increases from p_{n0} to p_{nd} . The experience of Australia which is reported in BG (1990) shows a clear link between inflation and commodity booms, and further when the monetary policy shifted from a fixed rate regime to a flexible regime, the inflation response to the booms diminished.

Conversely, a decline in the commodity price would lead to a decrease in p_n more acute under the fixed rate regime than under a flexible rate. This may explain in part why the FZ economies have traditionally a lower inflation rate than the neighbouring countries. Their relative good performance in the domain of price inflation is probably the main point generally noted at the credit of the Zone. The reason implied up to now is that the exchange rate regime with the peg to a key currency enables the

³⁷ We have assumed that the shift from the fixed rate regime to the flexible rate does not change the credibility of the Government economic policy so that the core inflation is identical under the two regimes.

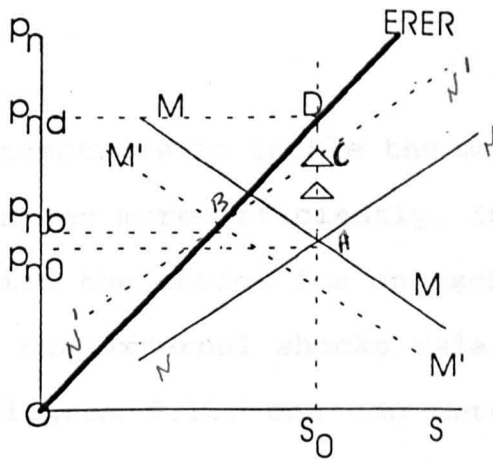


Fig 6.12: Adjustment under flexible rate and fixed rate regimes

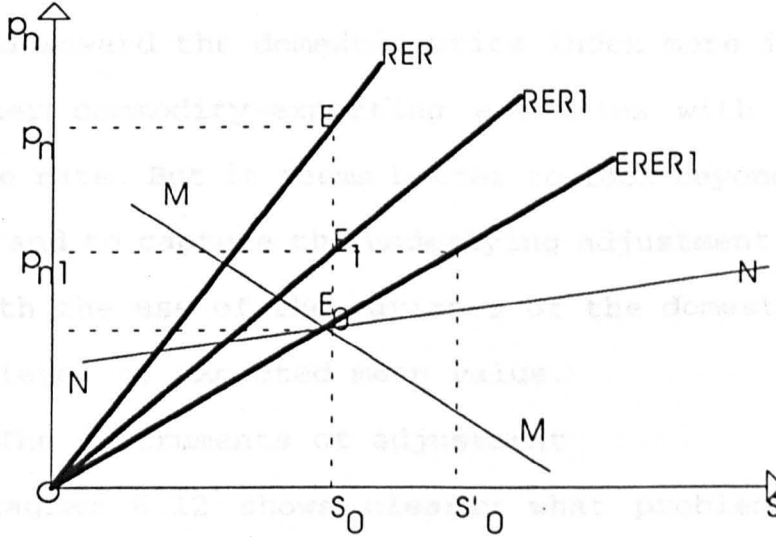
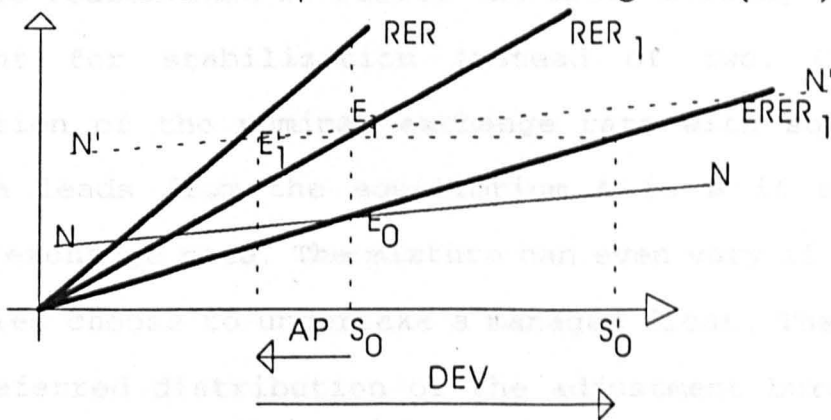


Fig6.13a: Comparison between the actual real exchange rate (RER) and the equilibrium real exchange rate (ERER).



Fgt13b: Introduction of third currency fluctuations

Notations: AP = appreciation due to 'Franc Fort' policy
DEV = 50% devaluation of January 1994

member countries to tackle the monetary shocks and other similar disturbances more efficiently. In this respect chapters 3 and 4 dealt with the choice for an exchange rate regime comparing the size of the external shocks relative to the monetary shocks.

From diagram 6.12, one can note further and more importantly that when the conditions of low commodity prices prevail, this drives downward the domestic price index more in the FZ than in the other commodity-exporting economies with a more flexible exchange rate. But it seems better to look beyond the price level as such and to capture the underlying adjustment pressures as was done with the use of the variance of the domestic price instead of its level or expected mean value.

(ii) The instruments of adjustment

The diagram 6.12 shows clearly what problem the fixed rate raises in an environment marked by important external shocks for the simple reason that it leaves the small economy with only one instrument for stabilization instead of two. Combining an appreciation of the nominal exchange rate with some degree of inflation leads from the equilibrium A to B if one adopts a flexible exchange rate. The mixture can even vary if the monetary authorities choose to undertake a managed float. They can choose their preferred distribution of the adjustment burden borne by the currency and the domestic price respectively. An extreme case would consist of maintaining the domestic price at p_{n0} and appreciating the nominal exchange rate sufficiently enough.

By contrast, the fixed rate regime presents the small economy with only the other extreme: to change only the price of the non-traded good and sufficiently enough to drive the economy back to

equilibrium.

Losing the exchange rate as an adjustment instrument is one thing. The fact that the exchange rate proves to be the most flexible instrument compared to the price index represents an additional worry when it comes to the fixed rate regime. The domestic price index includes a whole range of individual goods prices and it usually takes more time to get it move significantly in one direction than with the exchange rate (Friedman, 1953).

Another worry relates to the asymmetry which may characterize the domestic price behaviour. In the aftermath of a boom, one observes a rise in inflation as more income due to the bonanza boosts consumption. It is sometimes difficult to resist the increase in demand on the goods market and for the non-traded good in particular since this is the only way to take benefit of the bonanza (Forsyth & Kay, 1980). One way to prevent the boom from imposing inflationary pressure on the domestic economy and to "protect" the exchange rate might consist of investing the corresponding foreign exchange earnings in foreign assets . But this means keeping the level of consumption below the new level of real income with in counterpart the accumulation of external surplus (Neary & Wijnbergen, 1986).

But in the case of a collapse in the commodity price, the reduction in the budget of Government and other directly concerned agents, which should go with the decrease in real income, appears painful. Consequently, the necessary adjustments do not occur quickly enough.

Leaving the FZ countries with internal deflation as the only

mean to adjust in the face of commodity bust presented them with a very difficult policy decision.

Isard (1983) gives a general estimate of two to five years for the actual real exchange rate to converge to the long run equilibrium. This lag is deemed to be longer for economies like FZ's and even longer in face of a decline in the commodity prices than during commodity booms. Also one needs to take into account the fact that the real shocks which may affect a small open economy and influence the real exchange rate constitute a whole range of phenomena for which the terms of trade fluctuations give only an illustration if even the most significant one on the recent period. This leaves the EREER with important uncertainties and tracing precisely its movements as would be required in the context of fixed rate regime of the FZ economies represents a difficult task. In contrast a flexible rate would enhance the adjustment process.

(iii) Distinction between RER and EREER

As a matter of fact, the FZ countries did not adjust fully to the shocks of the mid-1980's on. One may find elements of an inappropriate economic policy in the lack of adjustment. For example some countries continued to increase the price to the crop growers while the commodity price was crumbling down on the world market. In any case, the reaction to the new situation was very late. In parallel some countries resorted to external borrowing instead of cutting in the Government budgets, a policy which contributed for much in the huge increase in the external debt.

However, there exist indications that the internal deflation

required was out of proportion compared with the burden that the populations could reasonably accept, witness the dramatic events of social unrest many times reported in the capitals of the FZ countries in the past decade if these events can be related to the economic difficulties even though the political aspects might have played an important role as well (the emergence of some sort of "glasnost" wind in the subregion).

In fact the period from the mid-1980's saw a notable increase in the Government deficits as well as the balance of payments deficits. We indicated earlier on that paradoxically, the framework of the FZ as a pool a reserves and the support of France for the convertibility of the CFA currency favoured the continuation of these financial deficits.

The actual real exchange rate reflected these dis-equilibria. It may have increased somewhat to reflect the part of adjustment undertaken. But to take this increase as an improvement in the degree of competitiveness could be misleading on the issue of whether the CFA currency was overvalued or not. The best way would consist of looking at the equilibrium exchange rate as well as comparing the two rates to better assess the real need for the change in the parity.

In contrast to the actual real exchange rate, the equilibrium real exchange rate is by definition that rate which ensures equilibrium, notably the balance of payments equilibrium. Our hypothesis gives an EREER much higher than the actual RER during the decade up to 1993.

In this paper, we have singled out the terms of trade as the most important determinant of the EREER changes in the FZ

economies during the last decade. Nevertheless, it is worth noting that other variables (domestic and external) played a significant role, depending on specific sub-periods. Among these, one generally lists the relative rates of productivity growth, the Government budget operations, the commercial policy reforms and fluctuations in international interest rates (Aghevli, Khan & Montiel, 1991).

We have the diagrams 6.13a and 6.13b similar to diagram 6.12, to illustrate the overvaluation issue. Due to the (S, p_n) space chosen for the graphical representation a move upwards vertically on the diagram corresponds to a real appreciation and a move downwards to a real depreciation.

The point E_0 denotes the initial equilibrium. We choose to take it as representative of the situation of the FZ before the commodity market boom in the 1970's. The prices did not remain steady at that high level during the whole period until the mid-1980's. Some fluctuations characterized this intermediate period. The situation differed from one commodity to another but one can note that most of them had their prices relatively high in the first half of the 1980's. We represent this favourable situation as the equilibrium point E where the real exchange rate has appreciated compared with the initial point E_0 . Given that much less rigidity opposes the rise in the domestic price, no distinction is drawn between the actual real exchange rate and the equilibrium real exchange rate for the economic situation pictured by the point E. This requires the MM line to move right to reach this point.

Now let us assume that the bust occurs and that this means the

commodity price falls back to its level before the boom. With respect to the experience of the FZ economies, such an assumption might appear rather optimistic. The decline in the commodity price reached a scale which took the new price below the pre-boom level for some commodities. If one considers the purchasing power of the export price, in other words the commodity price in real terms, this assessment is even more valid for most of the commodities. So for the sake of simplifying the presentation, we consider that the new equilibrium real exchange rate would correspond to the line $ERER_1$.

We assume that after the slump on the commodity markets, some adjustment has been achieved but at a very limited extent. The adjustment process which operates only by internal deflation takes a longer time. The limited adjustment leaves the actual real exchange rate half way to the long run equilibrium point. On the diagram this corresponds to the move from E (RER) to E_1 (RER_1). Compared to the level RER which prevailed during the boom period and which does not correspond to the present circumstances of the slump any more, the new real exchange rate has actually improved the degree of competitiveness. But this improvement falls notably short of the equilibrium value corresponding to the post-boom situation that is $ERER_1$. The gap between RER_1 and $ERER_1$ constitutes the thrust of our argument. It indicates that the adjustment was not completed yet raising a decision problem. Either the FZ countries should proceed with the internal deflation whatever the social consequences or use the second instrument and undertake the first ever devaluation of the CFA currency. The change in the parity corresponds to the shift from

S_0 to S_0' whereby the price of the non-traded good can be maintained at p_{n1} (after the initial adjustment from p_n), without a further reduction.

(iv) Appreciation of the FF.

As if the bust in the commodity market was not enough, another shock struck the FZ countries. This second disturbance took the form of the appreciation of the French Franc with respect to the dollar. This change between the two currencies may be best illustrated as a decrease in the dollar than as an increase in the French Franc if one refers to the sharp rise in the dollar during the early 1980's. Nevertheless the policy of "franc fort" in the context of the European Monetary System (EMS) has been noticed by several observers as a fact which has characterized the appreciation of the French Franc in the recent period.

In our notations, the nominal exchange rate S_0 represents the value of the dollar in CFA via the peg to the FF (1FF = 50 FCFA before devaluation and 1FF = 100 FCFA after devaluation). Because of this peg, the fluctuations between the FF and the dollar have the nature of external shocks for the small economy just as the terms of trade shocks. We note in this respect that Branson et al (1980) counts the movements of the exchange rates among the elements of the terms of trade variations. The appreciation of the FF has an effect similar to a decline in the terms of trade and vice-versa. It results from the position E_1 in fig 6.13b (the same as in fig 6.13a), moving to E'_1 along $N'N'$. At E'_1 , the inflation pressure is less than at E_1 but the real exchange rate has appreciated. If the decision is to stop the internal deflation and to resort to the use of the exchange rate

instrument with an once-step change in the parity, then the devaluation Dev is designed to bring the real exchange rate at its equilibrium on the $ERER_1$ line.

6.3. The experience of the FZ

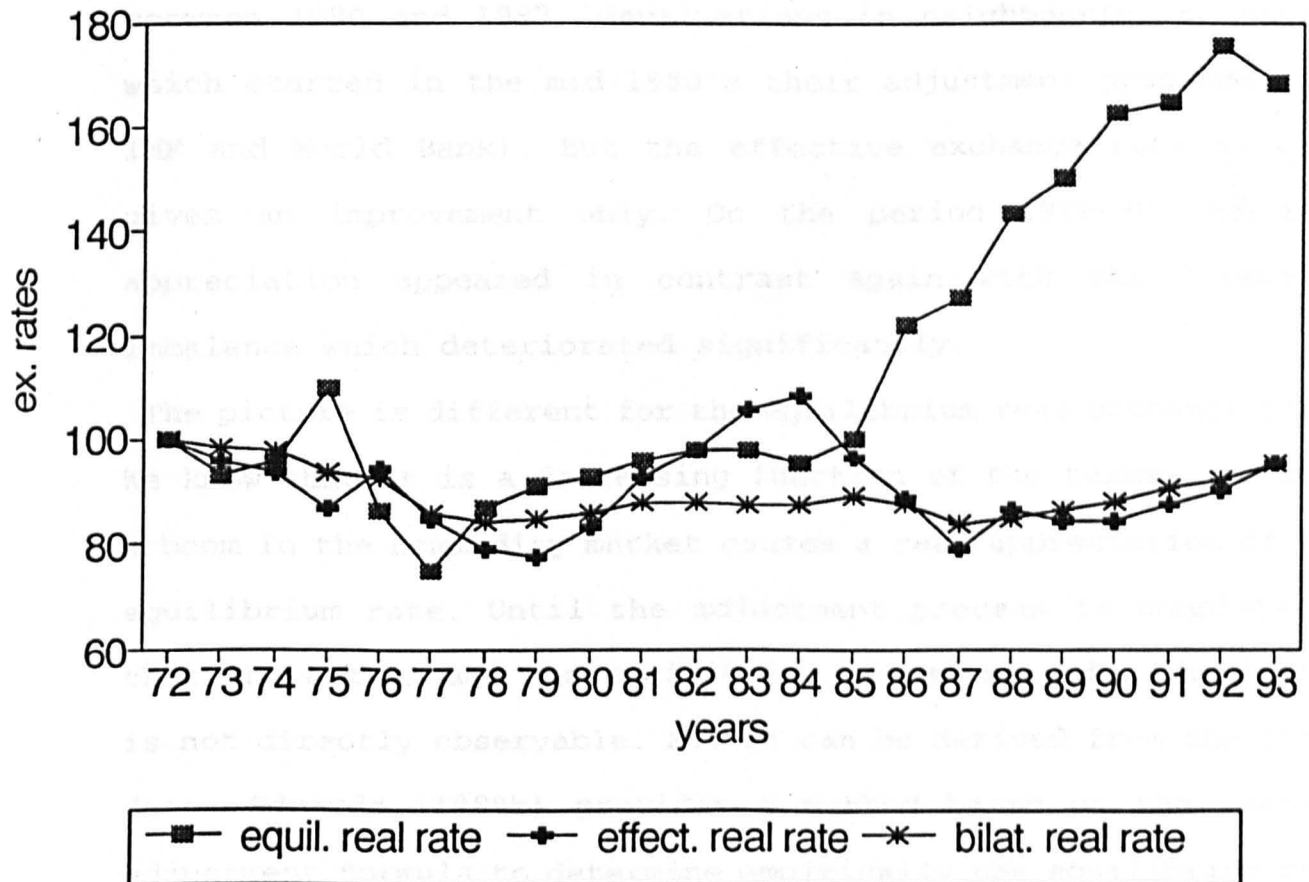
The data show that the financial situation in the African group of the FZ has worsened since 1978. In particular the overall balance of payments deficit as a percentage of GDP reached unprecedented levels by 1993. Against this background, let us now look at the traditional indicators used to assess the degree of overvaluation, if any, of the CFA franc (cf Boughton 1991), namely the actual real real exchange rate. Fig 6.14 gives an illustration.

a. Bilateral and effective real exchange rates.

The first instrument of measure is based on the bilateral rate between the currency of the small country and the key currency of the large country. Because the CFA is pegged to the FF, the bilateral real exchange rate will be determined here simply as the relative prices in France and the rest of the FZ. We will use the consumer price indexes to calculate the real exchange rate³⁸. The bilateral rate indicates that a real depreciation occurred from 1980 on, inflation being lower in CFA FZ than in France (fig 6.14). But this is the actual (bilateral) rate and the real depreciation should be contrasted with the increasing

³⁸ There exist different ways to specify the real exchange rate: use of consumer price indexes, GDP deflators, wholesale price indexes or unit labor costs. A discussion on this can be found in Dornbusch & Helmers (1988) and Joshi (1990).

Fig 6.14: Real ex. rate of the Afr. FZ
countries: actual and equilibrium rates



deficit of the balance of payments over the period under review. In this respect, the actual bilateral rate does not seem to be the most appropriate instrument of measure for the overvaluation of the CFA currency.

One further step to improve the measure is to use the effective exchange rate, because unlike the bilateral rate the effective rate picks up the fluctuations between third currencies (e.g. depreciations and appreciations of the FF vis-a-vis the dollar between 1980 and 1987, devaluations in neighbouring countries which started in the mid-1980's their adjustment programs with IMF and World Bank). But the effective exchange rate as such gives an improvement only. On the period 1978-90, no real appreciation appeared in contrast again with the financial imbalance which deteriorated significantly.

The picture is different for the equilibrium real exchange rate. We know that it is a decreasing function of the terms of trade. A boom in the commodity market causes a real appreciation of the equilibrium rate. Until the adjustment process is complete so that the actual and the equilibrium rates coincide, the latter is not directly observable. But it can be derived from the other data. Edwards (1989b) provides a method based on the partial adjustment formula to determine empirically the equilibrium real exchange rate. We argue that in the context of the FZ where there remained a substantial degree of financial imbalance, only the comparison of the actual real exchange rate to the equilibrium rate can give the full extent of the overvaluation of the CFA currency. During the period 1978-90, the actual real exchange rate did not appreciate while the equilibrium real rate

depreciated largely. The increasing distance between the actual and equilibrium rates, represents the scale of overvaluation of the CFA. Fig 6.14 shows the terms of trade as a proxy of the equilibrium real exchange rate (before introducing the scaling factor). By 1993, the index of the actual real exchange rate is about 95 (basis 1972 = 100) compared to an index level 170 for the equilibrium rate. This difference illustrates the extent of the overvaluation just before the devaluation occurred. but for a more precise comparison, the curve "ERER" which in fact is simply the inverse of the terms of trade needs to be scaled by the ratio K_1/K_2 (cf section 4.2 c chapter 4). Also the curve corresponding to the effective real rate or actual real rate, because it represents the ratio of CPI's needs to be scaled by the factor λ . Considering the values of table 4.2 (chapter 4), an acceptable estimate corresponding to $\alpha = \eta = 1$ and $\lambda = 0.5$) for the African FZ countries would give in 1993 the level of ERER at 152.3 and of actual RER at 90. This would give a difference equivalent to 40% to compare with the devaluation rate of 50%. This suggests that although the devaluation was a necessity, there might have been a bit of "overdevaluation". One possible reason for that may be that the determination of the devaluation rate was based not on the FZ average but on the worst case of overvaluation among the African FZ countries, presumably Cote d'Ivoire (Le Monde, January 13th, 1994).

b. Modelling the actual real rate

The previous analysis need to be completed. The discussion based on diagram 6.13 related to the equilibrium and actual real

exchange rate. But the model itself developed in subsection b) basically deals with the equilibrium real exchange rate only. As we have underlined it, the difference between the two indicators matters in a context where financial imbalances persist, for example when the balance of payments is ridden by large deficits. The question does not arise for the flexible exchange rate regime in the sense that this regime ensures continuously an external balance. But it does with a fixed exchange rate regime. The disequilibria that the African FZ countries have experienced suggest that the actual real exchange rate differed substantially from the equilibrium rate. This implies that the model be refined consequently to describe the actual real exchange rate.

Let us consider the fixed exchange rate regime. The nominal exchange rate is given equal to S_0 and normalized to unity. We rewrite the model in section 6.2b) as follows:

$$M/P = ky \quad (29)$$

$$y = y(p_x^*, 1/p_n) \quad (30)$$

$$P = P(p_n) \quad (31)$$

$$y_n(p_n, p_x^*) = d_n(p_n, E, M/P) \quad (32)$$

$$y = E + T \quad (33)$$

Two new variables appear in this setting³⁹. E represents the level of real expenditure and T is the trade balance (T presents some similarities with the hoarding variable in Dornbusch, 1986). We take E as an exogenous variable. The equilibrium equation on

³⁹ A more detailed description of the setting is given in section 6.2b

the market of the non-traded good has been slightly modified where the real expenditure E replaces the real income y among the explanatory variables of the demand for the non-traded good. Equation (33) defines the variable T .

The joint equilibrium on the money market and the non-traded good market will be called the instantaneous equilibrium. It differs from the long run equilibrium which is obtained when in addition, we have the external balance ($T = 0$). What the instantaneous equilibrium requires for the traded good is simply a world market equilibrium. The trade balance normally represents the disequilibrium between the domestic production and consumption of the traded good. But given that we have an equilibrium on the non-traded good market, the excess demand for the traded good equals the overall excess demand in the domestic economy, and that is the sense of equation 33.

We note also that in the fixed exchange rate the variable M becomes endogenous in a sense which refers to the steady state value of the money stock whereas reference to the price specie flow mechanism applies to the move from the instantaneous equilibrium to the long equilibrium, during which the change in the money stock equals the value of the trade balance. Differentiating the two equations (29) and (33) with substitution of the other equations would bring about the following equations:

$$\left(k \frac{\partial y}{\partial c} \frac{1}{p_n^2} - \frac{M}{P^2} \frac{\partial P}{\partial p_n}\right) dp_n + \frac{dM}{P} - k \frac{\partial y}{\partial p_x^*} dp_x^* \quad (34)$$

$$\left(\frac{\partial y_n}{\partial p_n} - \frac{\partial d_n}{\partial p_n} + \frac{M}{P^2} \frac{\partial d_n}{\partial m} \frac{\partial P}{\partial p_n} \right) dp_n - \frac{\partial d_n}{\partial m} \frac{dM}{P} - \frac{\partial y_n}{\partial p_x^*} dp_x^* + \frac{\partial d_n}{\partial E} dE \quad (35)$$

From this two-equation system one can extract the change in the price of the non-traded good:

$$\left(\frac{\partial y_n}{\partial p_n} - \frac{\partial d_n}{\partial p_n} + k \frac{\partial d_n}{\partial m} \frac{\partial y}{\partial c} \frac{1}{p_n^2} \right) dp_n - \left(k \frac{\partial d_n}{\partial m} \frac{\partial y}{\partial p_x^*} - \frac{\partial y_n}{\partial p_x^*} \right) dp_x^* + \frac{\partial d_n}{\partial E} dE \quad (36)$$

The signs in equation (36) are determinate. It can be seen that the coefficients of dp_n and dp_x^* are positive, giving the same result as before with regards the real exchange rate as a function of p_x^* . The last term in equation (36) reflects the effect of a change in the level of expenditure on the actual real exchange rate. As one would expect, an exogenous increase in the domestic expenditure will cause an increase in the price of the non-traded good and consequently a real appreciation of the actual rate and conversely. As can be seen from equation (33), such an exogenous increase in expenditure corresponds to a deterioration of the trade balance. In terms of the diagram 6.13 a balance of payment deficit and the corresponding real appreciation would mean starting from the equilibrium E_0 for example and moving towards the point E_1 which is simply an instantaneous equilibrium. It is understood that the zone vertically above E_0 depicts the cases of overvaluation and the zone below the cases of undervaluation.

An alternative way of introducing the effect of financial imbalances would be to keep the model as defined initially,

except for the second equation modified to include the fiscal stance (Miller & Williamson, 1988):

$$M/P = ky \quad (12)'$$

$$y = y(p_x^*, g, 1/p_n) \quad (13)'$$

$$P = P(p_n) \quad (14)'$$

$$y_n(p_n, p_x^*) = d_n(p_n, y, M/P) \quad (15)'$$

The variable g denotes the fiscal stance. Changes in g will replicate the exogenous changes in E above. In practice, one may interpret it as the fiscal deficit or the amount of external borrowing or even the (state variable) external debt. In any case, we will assume that the level of output responds positively to the variable g : $\partial y / \partial g > 0$. This specification is also compatible with the result obtained by Branson et Buiter (1983) that writing the domestic price as a function of the nominal exchange rate will ensure a fiscal effect on output.

With this specification, the differential equations as established in the expressions (21) and (22) are augmented with terms related to the change in g :

$$Adp_n = BdS + k\partial y / \partial p_x^* . dp_x^* + k\partial y / \partial g . dg \quad (37)$$

$$Cdp_n = DdS + (-\partial y_n / \partial p_x^* + \partial d_n / \partial y . \partial y / \partial p_x^*) dp_x^* + \partial d_n / \partial y . \partial y / \partial g . dg \quad (38)$$

with the same notations for the coefficients A , B , C and D as in section b). In particular, we recall that:

$$B-A > 0$$

$$C-D > 0$$

The way the real exchange rate will change following a change in the exogenous variables p_x^* and g can be derived:

$$dRER \equiv - \left[\frac{B-A}{BC-AD} \left(\frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial p_x^*} - \frac{\partial Y_n}{\partial p_x^*} \right) + \frac{C-D}{BC-AD} k \frac{\partial Y}{\partial p_x^*} \right] dp_x^* \\ - \left[\frac{B-A}{BC-AD} \frac{\partial d_n}{\partial Y} \frac{\partial Y}{\partial g} + \frac{C-D}{BC-AD} k \frac{\partial Y}{\partial g} \right] dg \quad (39)$$

It appears clearly from equation (39) that an increase in the Government deficit, everything else being equal, will appreciate the real exchange rate.

We may define the equilibrium real exchange rate as the level of the real exchange rate when the variable g equals zero, corresponding to a balanced Government budget for example or to the reduction of the external debt back to a predetermined level. Then any non-zero level of g implies a misalignment of the real exchange rate. In terms of diagram 6.13, the presence of the fiscal imbalance ($g > 0$) drives the economy to the location at point E_1 from the equilibrium point E_0 . The distance E_1E_0 illustrates the extent of the overvaluation.

Conclusion

The 50% devaluation of the CFA in January 1994 was long overdue. Among the reasons for this long delay with its damaging consequences, we have chosen to develop the view that the indicator used in the past to assess the overvaluation of the CFA

was not the right one. The analysis is based on a version of the trade-theoretic model taking into account the monetary aspects (cf Neary & Wijnbergen 1986) in the adjustment process after a terms of trade shock.

We argue that the actual real exchange did not reflect properly the situation of the CFA overvaluation. Instead of an assessment based on the actual real rate as did some studies, the comparison of the actual and equilibrium real rates seems more appropriate in the context of the FZ. The financial imbalances give ample evidence that the adjustment process was not complete from the mid-1980's on after the collapse of the world commodity prices.

The model gives an account of the equilibrium exchange rate with the usual property of real appreciation when the terms of trade increase. It displays the inflation pressure more important under a fixed exchange rate than under a flexible exchange rate in face of external shocks. Of course the small economy may attempt to operate an internal deflation to counter this inflation and get back to equilibrium. The African FZ countries had tried this procedure but the process had proved very painful. Because the adjustment was not complete, this draws a distinction between the actual real rate and the equilibrium real exchange rate. The distance between the two rates gives the scale of the overvaluation. As a matter of fact, one can note that the use of the actual real exchange rate has not detected a real appreciation of the CFA currency on the last fifteen years while the external imbalances were running deep. With the introduction of the equilibrium real rate, the overvaluation appears clearly instead.

Modelling the actual real exchange rate does not raise a difficulty. One can add in the model the domestic expenditure together with the trade balance or the fiscal stance.

General Concluding Remarks

From the experience of the African FZ countries, during the last decade, one can draw two lessons. The first one relates to the care required in assessing the degree of overvaluation of a given currency. These countries had an inflation rate comparable to the inflation rate of the large country whose currency is used for the fixed rate peg. Consequently, there was a fairly stable level of the bilateral real exchange rate of the small economy vis-a-vis the large economy. Even the effective real exchange rate proved to be stable. But at the same time, the financial imbalances especially the current account deficits were accumulating. This suggests that the actual real exchange rate by itself does not always give a full account of the overvaluation problem. It needs to be compared to the equilibrium real exchange rate.

The second lesson is about economic management policy. A number of authors have underlined the importance of macroeconomic policies compared with the shocks affecting a given small economy. The former seem to predominate the latter as the explanatory factor for the difficult economic experiences in Africa and Latin America versus the more successful case of Asia. The specific experience of the African FZ countries tends to support the findings that budget deficits and misalignments are generally the root causes of economic crisis in the developing world. The misalignment very often results from high inflation. However this is not the only source, the case of the FZ shows

that it may be due alternatively to an inappropriate exchange rate policy, depending on the circumstances which prevail in the small economy. Typically the unchanged fixed rate in the presence of large commodity price disturbances was causing prejudice to the African FZ countries. The first ever devaluation of the CFA currency in January 1994 came very belatedly.

On this and other aspects regarding the choice of an exchange rate regime, the different chapters above give a framework and an investigation designed to fit the case of a small commodity-exporting economy.

The question of Commodity Stabilization Funds has been introduced in chapter 5, and has gone some way to establish the economic rationale for this category of Funds. However further research may be necessary to establish undertaken on the link between saving rule and exchange rate rule, for example by dropping the assumption of no transactions costs used in our analysis. Chapter 5 indeed has explored the possibility of using the intertemporal optimization method to compare different exchange rate regimes.

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Appendix 1 a

Determination of the eigenvalues and eigenvectors of the matrix A (cf equation 12 chapter 4)

The matrix A is rewritten as follows:

$$A = \begin{pmatrix} -K_2 & K_2 \\ \frac{\lambda}{\varepsilon} & \frac{(1-\lambda)}{\varepsilon} \end{pmatrix} \quad (1)$$

Its determinant is:

$$\text{Det } A = -K_2 / \varepsilon < 0 \quad (2)$$

The different parameters in these expressions are defined in section 4.1. Since $\det A$ has a negative value, there exist two eigenvalues and two corresponding eigenvectors. The determination of the eigenvalues will involve solving:

$$|A - rI| = (-K_2 - r)[(1-\lambda)/\varepsilon - r] - (\lambda/\varepsilon)K_2 = 0 \quad (3)$$

$$\Rightarrow r^2 + [K_2 - (1-\lambda)/\varepsilon]r - K_2/\varepsilon = 0 \quad (4)$$

We calculate the discriminant Δ :

$$\Delta = [K_2 - (1-\lambda)/\varepsilon]^2 + 4K_2/\varepsilon > 0 \quad (5)$$

the roots are as follows:

$$r_1 = \frac{-(K_2 - \frac{1-\lambda}{\varepsilon}) - \Delta^{\frac{1}{2}}}{2} \quad (6)$$

$$r_2 = \frac{-(K_2 - \frac{1-\lambda}{\varepsilon}) + \Delta^{\frac{1}{2}}}{2} \quad (7)$$

It appears clearly that r_1 is negative and corresponds to the stable manifold while r_2 is positive and corresponds to the unstable manifold.

To determine the stable manifold or eigenvector

$\begin{pmatrix} 1 \\ \theta_1 \end{pmatrix}$ we write that it satisfies the relationship:

$$A \begin{pmatrix} 1 \\ \theta_1 \end{pmatrix} = r_1 \begin{pmatrix} 1 \\ \theta_1 \end{pmatrix} \quad (8)$$

$$\Rightarrow -K_2 + K_2\theta_1 = r_1 \Rightarrow \theta_1 = (K_2 + r_1)/K_2 \quad (9)$$

It can be shown that θ_1 is less than zero, and greater than -1 ($-1 < \theta_1 < 0$), implying the "overshooting" of the exchange rate

in the system represented by equation (11).

From equation (9) the speed of adjustment $K_2 (1-\theta)$ equals $-r_1 > 0$. Differentiating (4) with respect to K_2 indicates that:

$$dr_1/dK_2 < 0$$

Thus the speed of adjustment is an increasing function of K_2 . Consequently it will be an increasing function of ϕ , α and η . With regards the parameter λ , we note that K_2 will be an increasing function if $\alpha-\eta > 0$, and vice-versa. The same will apply for the speed of adjustment as a function of λ . The case of ε would require more extended calculations not done here.

Appendix 1b

We consider

$$D = (\eta - \alpha)\lambda^2 - 2\eta\lambda + (1 - \alpha)\eta \quad (1)$$

as a function of λ . How the sign of D will depend on λ ? To answer this question, let us calculate the discriminant Δ :

$$\Delta = \eta^2 - (1 - \alpha)\eta(\eta - \alpha) = \eta\alpha(1 + \eta - \alpha) \quad (2)$$

1) For $1 + \eta - \alpha < 0$, Δ is negative, which implies D has the same sign whatever the value of λ .

2) For $1 + \eta - \alpha > 0$, Δ is positive, which means the equation $D = 0$ has two solutions:

$$\lambda_1 = \frac{\eta + [\eta\alpha(1 + \eta - \alpha)]}{\eta - \alpha}$$

$$\lambda_2 = \frac{\eta - [\eta\alpha(1 + \eta - \alpha)]}{\eta - \alpha}$$

The solution λ_1 is positive and higher than 1 every time $\eta - \alpha > 0$. Otherwise, it is negative. In both cases, λ_1 is outside the range $[0, 1]$ in which λ should be by definition.

The investigation is then reduced to the analysis of λ_2 . The sign of the numerator of λ_2 is given by $(\eta - \alpha)(1 - \alpha)$. Since the denominator is $\eta - \alpha$, λ_2 has the same sign as $1 - \alpha$, in particular λ_2 is positive only if $\alpha < 1$. Furthermore, one can see that λ_2 is always less than 1.

In summary: i) $\eta - \alpha > 0 \Rightarrow \lambda_1 > 1$

$1 - \alpha > 0 \Rightarrow 0 < \lambda_2 < 1$. D will be positive for $\lambda < \lambda_2$ and negative for $\lambda > \lambda_2$ (the permissible range of λ being $[0, 1]$).

ii) $\eta - \alpha < 0 \Rightarrow \lambda_1 < 0$

$1 - \alpha > 0 \Rightarrow 0 < \lambda_2 < 1$. D will be positive for $\lambda < \lambda_2$ and negative for $\lambda > \lambda_2$.

iii) $\eta - \alpha > 0 \Rightarrow \lambda_1 > 1$

$1 - \alpha < 0 \Rightarrow \lambda_2 < 0$. D will be negative for whatever λ in the permissible range.

iv) $\eta - \alpha < 0 \Rightarrow \lambda_1 < 0$

$1 - \alpha < 0 \Rightarrow \lambda_2 < 0$. D will be negative for whatever λ in the permissible range.

Appendix 2

- Figures 6.a to 6.d

- Tables 1 to 4

Sources:

1) for producer prices: "Notes d'information", BCEAO

2) for market prices: Datastream

Fig 6a: Cocoa market price index and producer price index

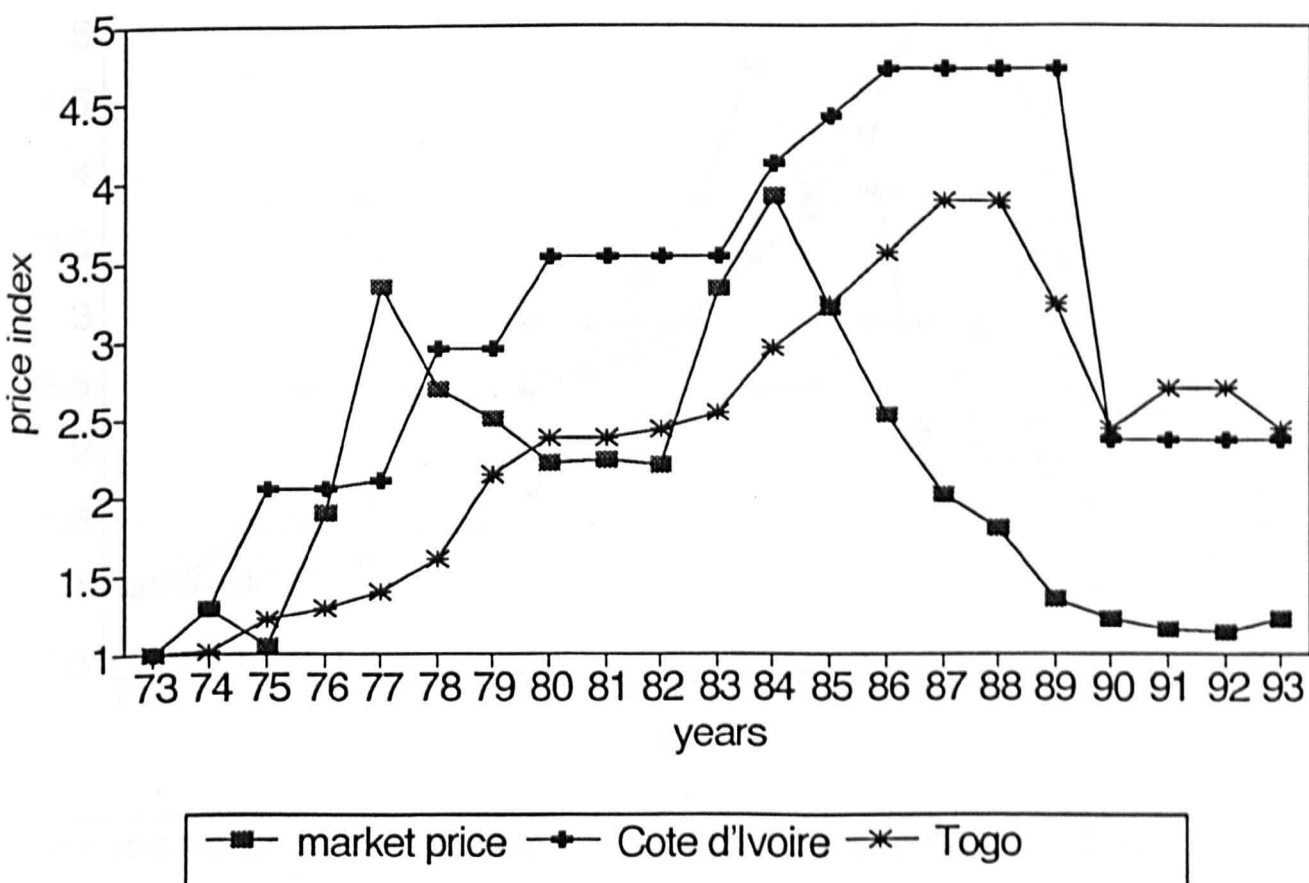


Fig 6b: Coffee market price index and producer price index

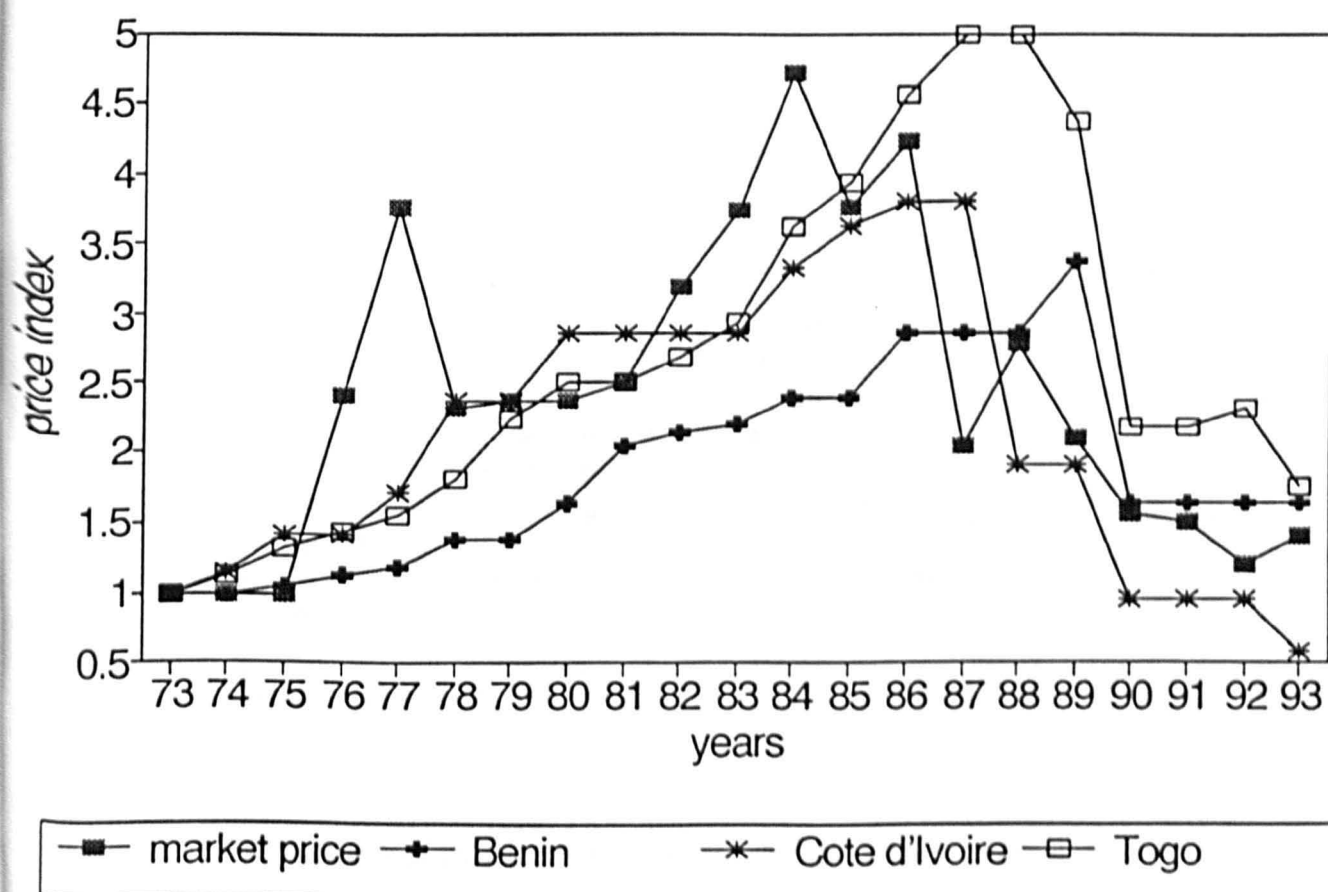


Fig 6c: Cotton market price index and
producer price index

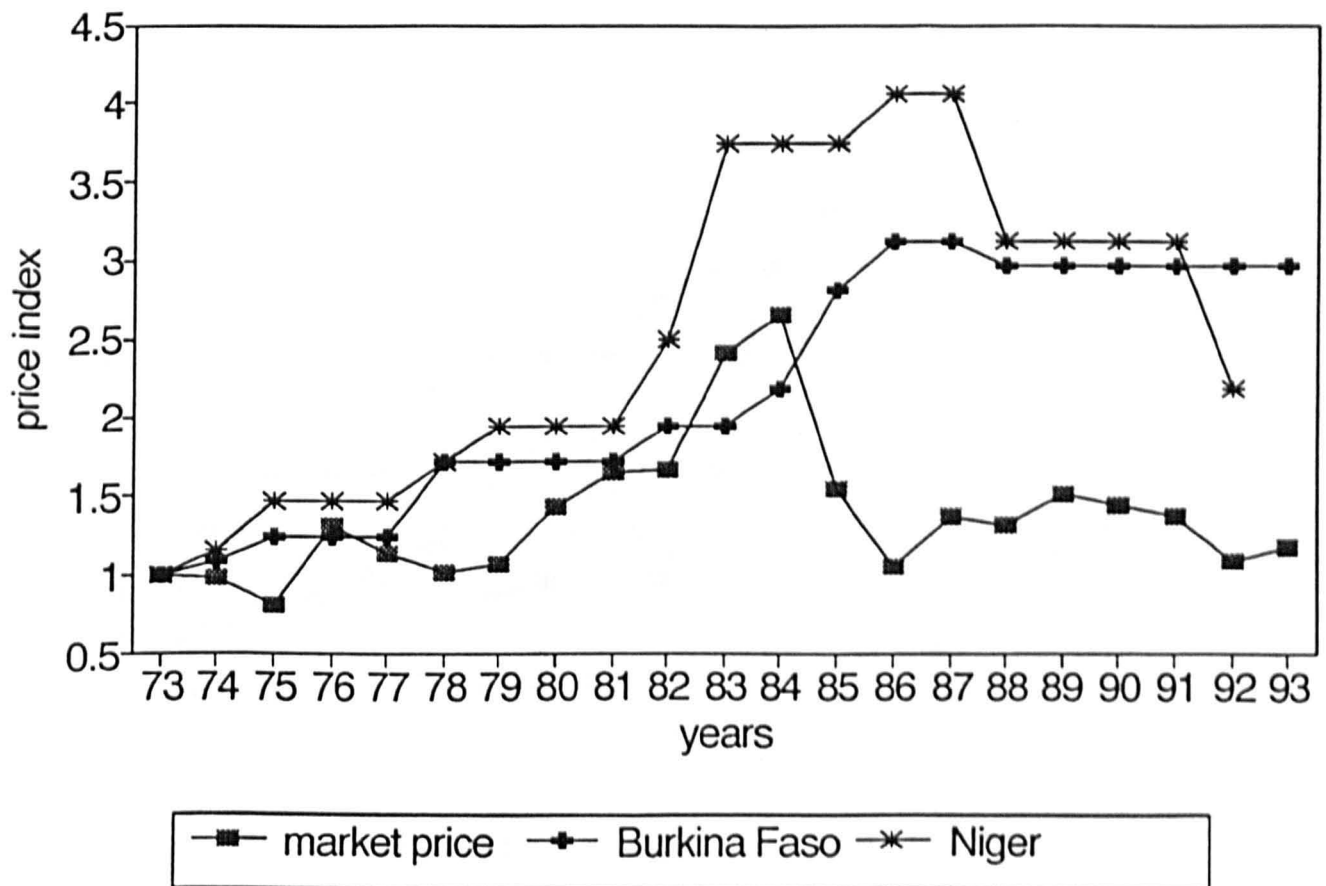


Fig 6d: Groundnut market and
producer price index

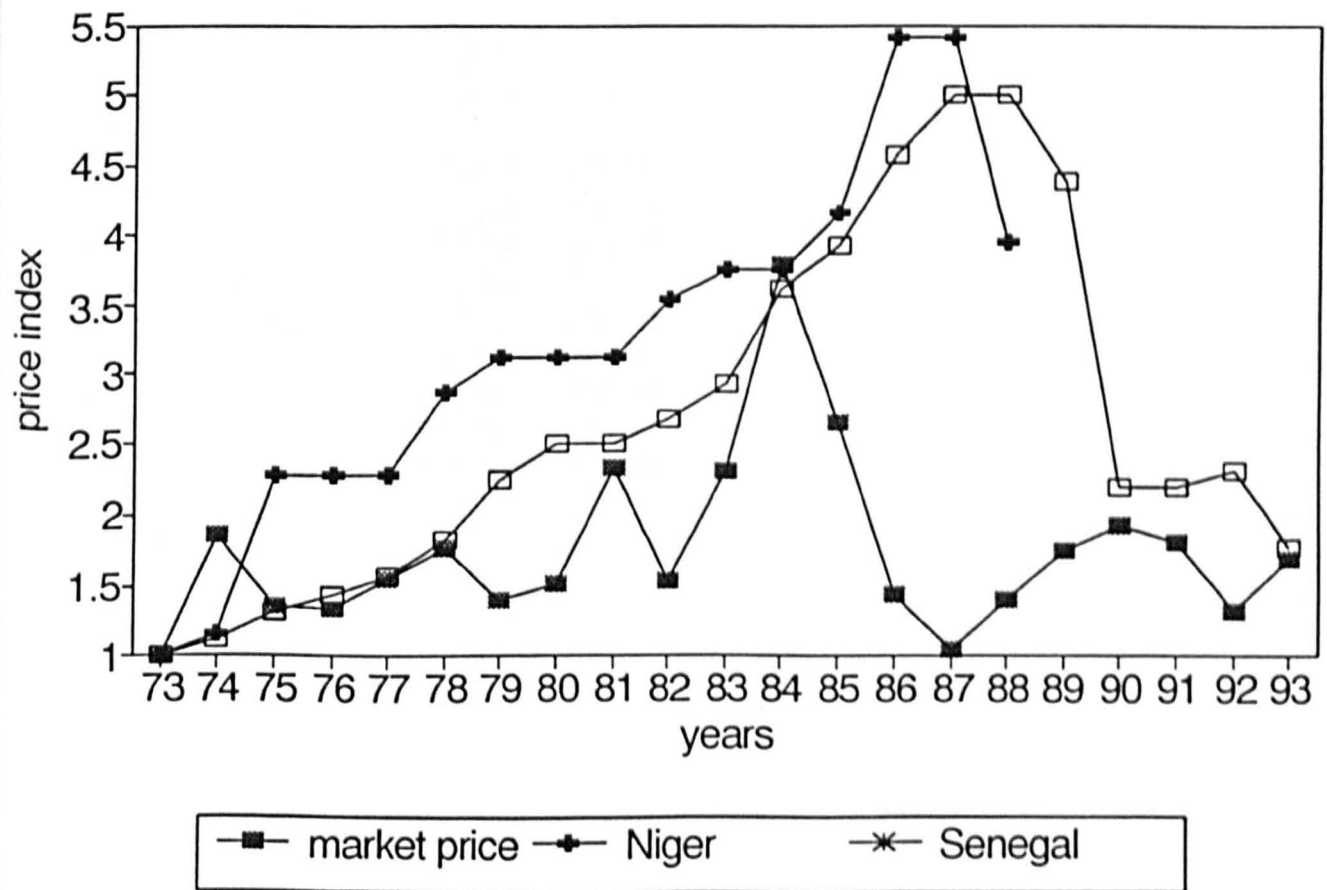


Table 1
COCOA
prod. price CFA (FCFA/kg)

	Benin	Cote d'Ivoire	Togo
1972	95.00	85.00	93.00
1973	125.00	110.00	95.00
1974	250.00	175.00	115.00
1975	250.00	175.00	120.00
1976	250.00	180.00	130.00
1977	250.00	250.00	150.00
1978	250.00	250.00	200.00
1979	250.00	300.00	220.00
1980	250.00	300.00	220.00
1981	...	300.00	225.00
1982	...	300.00	235.00
1983	...	350.00	275.00
1984	...	375.00	300.00
1985	...	400.00	330.00
1986	...	400.00	360.00
1987	350.00	400.00	360.00
1988	320.00	400.00	300.00
1989	320.00	200.00	225.00
1990	320.00	200.00	250.00
1991	320.00	200.00	250.00
1992	320.00	200.00	225.00

Table 2

COFFEE
prod. price CFA (FCFA/kg)

Benin Cote d'Ivoire Togo

1973	98.00	105.00	80.00
1974	98.00	120.00	90.00
1975	103.00	150.00	105.00
1976	110.00	150.00	115.00
1977	115.00	180.00	125.00
1978	135.00	250.00	145.00
1979	135.00	250.00	180.00
1980	160.00	300.00	200.00
1981	200.00	300.00	200.00
1982	210.00	300.00	215.00
1983	215.00	300.00	235.00
1984	235.00	350.00	290.00
1985	235.00	380.00	315.00
1986	280.00	400.00	365.00
1987	280.00	400.00	400.00
1988	280.00	200.00	400.00
1989	330.00	200.00	350.00
1990	160.00	100.00	175.00
1991	160.00	100.00	175.00
1992	160.00	100.00	185.00
1993	160.00	60.00	140.00

Table 3

GROUNDNUT
prod. price CFA (FCFA/kg)

Niger Senegal

1973	24.00	23.10
1974	28.00	25.50
1975	55.00	41.50
1976	55.00	41.50
1977	55.00	41.50
1978	69.00	41.50
1979	75.00	41.50
1980	75.00	45.50
1981	75.00	50.00
1982	85.00	70.00
1983	90.00	70.00
1984	90.00	70.00
1985	100.00	70.00
1986	130.00	90.00
1987	130.00	90.00
1988	95.00	90.00
1989	free	70.00
1990		70.00
1991		70.00
1992		80.00
1993		100.00

Table 4

COTTON

prod. price CFA (FCFA/kg)

Burkina Faso

Niger

1973	32.00	32.00
1974	35.00	37.00
1975	40.00	47.00
1976	40.00	47.00
1977	40.00	47.00
1978	55.00	55.00
1979	55.00	62.00
1980	55.00	62.00
1981	55.00	62.00
1982	62.00	80.00
1983	62.00	120.00
1984	70.00	120.00
1985	90.00	120.00
1986	100.00	130.00
1987	100.00	130.00
1988	95.00	100.00
1989	95.00	100.00
1990	95.00	100.00
1991	95.00	100.00
1992	95.00	70.00

Appendix 3

- Tables 5.1 to 5.11
- Tables 6 to 8

Sources: as indicated

Tables 5.1 to 5.11: Data summary, individual countries and FZ aggregate.

5.1 BENIN

	FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
1972	6.1		-8.6	2.4	...	10.5	83.1	127.2
1973	4.5		-14.3	1.5	...	11.2	89.0	192.4
1974	7.0		-29.3	0.5	...	11.8	107.6	126.1
1975	5.5		-53.4	-19.9	...	13.4	112.8	102.2
1976	6.3		-72.8	-2.8	...	12.8	133.5	134.8
1977	6.3		-60.7	-3.9	1.4	14.7	148.5	165.2
1978	0.9		-96.4	-19.2	5.1	14.4	161.6	139.1
1979	-2.1		-51.9	-3.6	-1.0	17.4	193.5	125.0
1980	-2.8		-35.7	-22.6	...	21.7	245.6	108.7
1981	13.5		-93.4	31.2	...	25.2	301.0	112.0
1982	-5.0		-377.2	-48.1	...	27.2	411.9	100.0
1983	-14.9		-134.8	-37.4	...	35.6	439.4	103.3
1984	-32.8		-57.1	-23.3	...	41.8	466.2	105.4
1985	-38.7		4.7	-29.5	...	42.2	499.8	100.0
1986	-32.8		-65.5	-71.2	...	43.6	502.7	72.8
1987	-54.6	95.1	-34.3	-130.8	-51.9	73.0	469.6	93.5
1988	-54.4	99.2	-52.0	-48.9	-46.2	63.6	482.4	89.4
1989	-20.2	99.7	12.2	-38.5	-51.0	53.2	489.7	90.9
1990	18.9	100.0	-29.4	38.0	-50.2	56.0	518.8	87.0
1991	29.5	100.9	-84.6	-27.6	-42.6	56.6	539.2	77.3
1992	52.6	104.4	-160.0	-67.7	-45.0	61.2	577.5	60.6
1993	63.0	107.7	-52.3	61.8	-26.3	60.8	611.0	66.1

5.2 BURKINA FASO

	FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
1972	11.6	29.6	3.5	2.3	...	9.5	109.4	191.4
1973	15.3	31.8	2.5	11.4	0.4	10.9	109.7	219.8
1974	17.4	34.6	-5.3	16.3	2.2	13.4	131.0	133.3
1975	15.9	41.1	-54.3	-6.3	-1.7	23.2	137.7	116.1
1976	12.6	37.6	-33.5	0.5	-1.3	21.2	149.4	146.9
1977	5.9	48.9	-84.3	-19.8	4.3	26.5	184.9	135.8
1978	-1.1	53.0	-59.5	-31.2	1.5	30.0	222.5	132.1
1979	1.5	60.9	-63.8	8.3	-5.6	49.2	252.5	133.3
1980	3.5	68.3	-48.7	6.6	0.9	47.4	272.0	123.5
1981	4.9	73.5	-42.1	14.2	-4.7	60.9	324.2	109.9
1982	1.8	82.3	-92.1	-0.2	-6.2	72.5	359.6	102.5

1983	14.4	89.2	-60.1	36.6	0.6	78.8	381.0	117.3
1984	31.7	93.5	-3.5	35.9	-3.4	76.9	390.6	117.3
1985	31.0	100.0	-60.1	5.7	6.3	72.6	469.3	100.0
1986	51.2	97.4	-20.7	41.9	-0.7	...	503.5	93.8
1987	71.8	94.8	-51.0	22.9	-66.9	101.9	607.9	108.6
1988	82.5	97.7	-31.5	30.6	-62.1	110.2	666.5	108.6
1989	68.5	98.4	49.3	-128.9	-53.3	118.6	693.7	108.6
1990	66.2	99.6	-94.2	-57.5	-52.9	124.3	702.6	108.6
1991	77.8	103.5	-92.7	26.5	-55.6	130.6	776.5	108.6
1992	91.0	101.5	-139.2	-1.6	-47.8	132.6	771.1	108.6
1993	88.4	103.3	-117.0	-56.4	-33.9	136.6	796.0	108.6

5.3 CAMEROON

	FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
1972	8.1	22.7	-91.6	0.0	...	46.0	355.9	105.4
1973	11.4	25.1	-16.7	0.0	...	49.0	400.5	123.9
1974	16.8	29.4	-17.0	-19.4	...	57.3	492.6	101.1
1975	0.3	33.4	-152.5	-17.9	-13.0	68.4	580.2	85.9
1976	-2.2	36.7	-92.2	-51.5	-15.9	74.8	657.2	127.2
1977	-4.1	42.1	-93.0	-2.6	-3.0	81.9	789.9	159.8
1978	-15.8	47.3	-186.9	-12.9	4.1	102.8	968.1	130.4
1979	10.0	50.4	-126.3	59.7	31.7	116.3	1135.4	113.0
1980	-4.5	55.2	-445.9	78.4	7.2	136.8	1356.2	108.7
1981	43.1	61.2	-482.0	-60.1	-58.5	159.1	1796.4	106.5
1982	-9.7	69.3	-386.0	-10.8	-55.2	192.0	2172.8	104.3
1983	59.6	80.8	-411.9	116.8	33.9	248.7	2618.1	102.2
1984	129.4	90.0	-168.9	-86.4	...	306.4	3195.0	104.3
1985	155.9	91.1	-561.5	58.7	...	345.3	3896.0	100.0
1986	-27.2	94.0	-550.9	-81.5	...	465.5	4135.0	67.4
1987	-110.8	114.2	-1219.3	-626.9	-508.0	429.0	3854.0	60.9
1988	-102.0	116.2	-1079.9	-367.8	-214.0	410.0	3386.2	53.6
1989	-174.2	118.0	-817.5	-269.9	-174.1	433.7	3363.0	45.5
1990	-130.2	119.8	-1077.0	-525.4	-276.9	429.2	3320.8	42.9
1991	-120.8	119.0	-914.8	-668.6	-245.6	412.3	3115.9	47.3
1992	-130.3	121.4	-965.1	-598.8	-186.3	387.1	2929.0	39.7
1993	-220.5	116.7	-1030.9	-1075.5	-194.3	361.6	2664.2	39.3

5.4 CENTRAL AFRICAN REPUBLIC

FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
-------	------	-----	----	-----	----	------	-----

1972	0.5	24.8	1.1	-1.4	...	...	55.6	103.5
1973	0.1	26.2	-3.0	-6.8	...	...	57.1	112.6
1974	-2.2	28.7	-14.6	3.1	...	...	72.0	98.9
1975	-4.0	33.3	-37.3	0.8	...	...	83.8	83.9
1976	0.6	36.8	5.4	15.2	...	...	94.1	118.4
1977	-1.3	40.9	-19.0	4.9	...	...	106.9	132.2
1978	-2.4	45.6	-24.4	-12.7	...	...	120.8	110.3
1979	3.4	49.8	-16.0	16.5	...	...	135.3	119.5
1980	6.2	58.4	-43.1	-0.8	...	...	168.4	114.9
1981	8.4	65.8	-4.3	-6.8	-6.7	...	218.1	101.2
1982	4.5	74.3	-42.6	-34.4	...	...	248.0	103.4
1983	6.8	84.2	-29.3	-14.1	...	...	251.5	102.3
1984	12.9	91.8	-33.4	0.6	...	...	278.7	109.2
1985	12.0	100.0	-48.6	-25.1	...	...	316.2	100.0
1986	13.9	107.6	-86.5	-3.0	...	...	330.9	97.7
1987	17.7	116.2	-47.5	20.3	-12.4	42.3	314.6	96.6
1988	18.5	113.8	-27.1	-0.0	-16.5	43.6	326.6	105.1
1989	19.1	118.2	-33.8	8.7	-13.0	45.5	340.9	101.5
1990	18.9	120.2	-96.9	-20.4	-17.7	47.9	351.6	107.6
1991	15.9	119.7	-59.6	-9.7	-21.6	48.1	354.5	97.9
1992	18.2	122.7	-50.4	7.2	-21.6	48.4	352.8	109.3
1993	20.2	125.3	-20.0	-22.6	-24.2	34.7	349.2	94.0

5.5 COTE D'IVOIRE

	FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
1972	20.1	24.3	-96.6	-71.8	...	77.2	471.8	92.7
1973	17.1	27.0	-219.3	-6.3	...	95.6	566.2	100.0
1974	29.5	31.7	-61.0	61.6	...	118.7	739.0	96.9
1975	2.3	35.3	-379.0	-92.4	...	141.8	834.5	83.3
1976	-2.6	39.5	-249.3	9.0	...	180.3	1120.4	119.8
1977	36.1	50.4	-177.3	118.1	...	209.7	1590.4	152.1
1978	44.8	56.9	-839.1	137.3	...	290.4	1783.0	126.0
1979	-37.2	66.4	-1383.3	-329.2	-168.3	353.8	1944.7	122.9
1980	-208.7	76.1	-1826.5	-664.3	-233.2	362.4	2149.9	104.2
1981	-366.9	82.8	-1411.4	-603.4	...	403.6	2291.4	88.5
1982	-394.4	88.9	-1017.2	-306.8	...	432.5	2486.5	90.6
1983	-597.8	94.2	-931.0	-699.1	...	439.3	2605.9	95.8
1984	-476.8	98.2	-76.8	-478.6	...	453.3	2989.4	104.2
1985	-328.8	100.0	63.7	-176.2	...	441.6	3134.8	100.0
1986	-331.0	106.8	-300.5	-379.5	...	485.9	3171.7	109.4
1987	-479.9	114.3	-793.4	-1127.5	-217.9	501.3	3117.8	91.7
1988	-570.7	122.2	-1178.6	-1853.4	-410.1	629.8	3069.2	79.1

1989	-564.1	123.4	-1057.6	-1414.3	-494.9	546.3	2985.2	68.0
1990	-560.5	122.6	-1199.8	-1557.4	-297.9	474.8	2693.0	56.5
1991	-541.6	124.6	-1366.2	-1347.2	-312.9	478.3	2690.2	56.9
1992	-556.5	129.8	-1363.9	-1847.2	-304.0	474.1	2684.8	55.7
1993	-542.3	130.8	-1017.7	-1966.5	-426.5	470.2	2633.0	57.7

5.6 CONGO

	FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
1972	0.4	29.3	-97.8	-7.4	...	27.6	91.0	75.5
1973	0.5	30.4	-78.3	-11.7	...	28.2	102.6	44.7
1974	3.8	32.0	-93.1	18.8	...	37.8	137.0	74.5
1975	-0.9	37.6	-248.9	-18.7	...	54.3	159.6	68.1
1976	-4.5	40.3	-227.3	-22.2	...	61.2	173.4	73.4
1977	-9.0	45.9	-193.3	-24.2	...	61.2	181.7	76.6
1978	-9.5	50.8	-180.6	-15.1	...	45.5	198.3	71.3
1979	-2.7	54.9	-99.4	23.1	...	...	254.5	78.7
1980	8.7	58.9	-166.7	47.0	-18.8	63.4	360.4	106.4
1981	23.9	68.8	-460.7	41.5	0.4	72.8	541.7	112.8
1982	4.5	77.7	-331.5	-83.9	-93.4	95.8	711.5	107.5
1983	-22.2	83.7	-400.9	-31.9	-26.7	120.0	799.4	102.1
1984	-37.2	94.7	210.2	-61.4	...	141.7	958.5	103.2
1985	-22.9	100.0	-161.3	-80.7	...	159.7	970.9	100.0
1986	-35.7	102.4	-600.7	-398.2	...	159.8	640.1	60.6
1987	-28.8	104.0	-222.7	-414.9	-89.4	142.1	690.5	68.1
1988	-34.3	108.2	-432.4	-471.3	-119.7	138.7	659.0	51.0
1989	-39.6	112.6	-63.0	-400.1	-78.1	144.6	774.9	60.9
1990	-4.2	114.8	-204.3	-252.8	-53.4	145.0	781.6	64.3
1991	-15.3	115.0	-406.8	-661.7	-134.3	204.0	788.6	52.8
1992	-15.3	117.4	-531.1	-635.6	-195.0	178.2	813.6	49.2
1993	-15.3	118.2	-444.5	-680.3	-152.9	175.5	675.4	49.6

5.7 GABON

	FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
1972	3.5	22.4	-3.7	-3.9	...	19.2	108.5	40.0
1973	7.5	23.8	-43.0	22.8	-17.6	25.1	161.1	38.9
1974	15.6	26.6	219.1	50.7	-15.5	34.4	371.7	77.8
1975	26.4	34.2	73.5	46.0	-37.0	56.5	462.4	68.9
1976	23.0	41.1	52.3	-17.1	-158.1	76.0	719.1	73.3

1977	-18.0	46.8	98.9	-111.2	...	124.9	690.2	71.1
1978	-19.3	51.8	73.9	8.2	...	73.8	539.2	67.8
1979	-16.1	56.0	247.6	-16.3	-3.5	77.9	644.6	80.0
1980	7.3	62.9	383.9	95.9	55.1	...	904.5	111.1
1981	32.3	68.3	403.3	117.8	8.2	...	1049.0	118.9
1982	84.1	79.7	309.4	146.7	35.1	...	1188.9	113.3
1983	72.5	88.0	97.9	-89.3	-16.3	...	1320.0	105.6
1984	92.3	93.2	112.7	13.1	3.1	284.4	1455.6	105.6
1985	47.9	100.0	-162.5	-60.9	1.1	306.3	1576.0	100.0
1986	2.8	106.4	-1057.5	-195.4	...	268.0	1590.0	62.2
1987	-35.3	105.3	-449.2	-522.4	-126.9	291.7	1232.7	71.1
1988	-30.6	95.0	-617.8	-306.4	-95.3	226.0	1140.9	60.9
1989	-9.8	101.3	-191.2	-383.5	-88.6	228.3	1344.4	74.9
1990	45.5	107.4	214.1	-248.8	-17.8	247.2	1494.5	63.1
1991	58.6	109.4	107.4	-211.8	27.3	255.0	1533.1	64.8
1992	-5.1	99.1	105.6	-442.3	-32.1	266.0	1565.2	62.3
1993	64.8	100.3	-7.1	-61.6	71.5	274.9	1603.0	83.1

5.8 NIGER

	FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
1972	11.0	27.8	7.9	2.2	...	15.0	136.0	171.7
1973	11.9	31.1	24.6	5.0	...	15.7	128.2	151.5
1974	10.7	32.2	-27.8	-6.4	...	17.4	159.0	126.3
1975	11.0	35.1	12.1	5.7	...	23.6	180.4	129.3
1976	18.8	43.4	-26.6	31.1	-5.5	28.1	237.9	135.4
1977	23.5	53.4	-95.6	13.4	-5.3	31.0	288.8	126.3
1978	20.0	58.8	-201.0	7.1	-12.6	34.0	359.2	136.4
1979	18.7	63.1	-137.6	-3.5	-12.1	41.0	443.2	123.2
1980	8.7	69.6	-275.7	-3.8	-25.2	54.0	536.2	101.0
1981	18.9	85.6	-181.5	2.7	...	70.2	601.5	101.0
1982	-24.0	95.5	-232.8	-63.3	...	81.0	663.0	105.1
1983	-19.7	93.1	-61.8	-11.9	...	87.5	687.1	108.1
1984	-2.6	100.9	1.2	-23.4	...	89.7	638.4	101.0
1985	5.2	100.0	-64.0	-45.6	...	97.2	647.1	100.0
1986	11.9	96.8	25.1	-48.4	...	102.3	659.6	95.0
1987	19.8	90.3	-79.4	-17.3	-63.6	103.6	671.1	83.8
1988	32.4	90.8	-61.7	-15.1	-72.2	105.0	679.2	75.3
1989	22.9	90.1	-88.7	-105.2	-73.1	124.4	695.3	68.2
1990	26.2	88.3	-94.3	-57.5	-81.8	117.6	675.4	61.4
1991	25.0	86.6	-7.3	-76.4	-23.6	100.0	656.6	56.9
1992	31.5	85.1	-44.8	-245.2	-29.2	110.0	620.6	52.8
1993	17.7	85.4	-29.1	-161.6	-17.0	115.9	628.7	51.9

5.9 SENEGAL

	FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
1972	5.8	24.1	10.7	5.3	...	40.8	273.6	113.4
1973	-3.4	26.8	-101.4	-31.7	-7.5	43.8	278.3	106.2
1974	-5.9	31.2	-65.6	-5.9	...	50.0	338.8	132.0
1975	-10.1	41.1	-85.6	-4.5	-2.2	61.8	406.4	121.6
1976	-10.7	41.6	-92.8	-19.1	...	71.7	459.3	117.5
1977	-12.9	46.3	-67.5	2.9	-15.1	77.9	487.5	116.5
1978	-35.8	47.9	-235.8	-59.4	1.5	91.1	494.1	104.1
1979	-63.3	52.5	-264.2	-27.0	-4.3	111.0	581.1	103.1
1980	-87.1	57.1	-386.6	-58.1	5.4	140.3	627.6	103.1
1981	-133.2	60.4	-462.3	-132.6	-22.6	150.7	669.8	105.2
1982	-172.8	70.9	-266.6	-234.1	-52.3	173.8	844.3	101.0
1983	-198.8	79.2	-306.1	-110.1	-55.5	177.8	924.9	102.1
1984	-225.2	88.5	-274.1	-98.2	-82.4	206.8	1015.5	104.1
1985	-258.8	100.0	-273.0	-89.5	...	213.0	1152.0	100.0
1986	-208.2	106.2	-268.2	-37.0	...	224.7	1307.0	88.7
1987	-204.7	101.8	-305.9	-52.3	-19.7	215.6	1382.3	92.8
1988	-250.7	99.9	-286.2	-368.1	-16.8	218.1	1483.3	86.7
1989	-220.3	100.4	-185.4	14.7	-30.9	229.8	1476.5	85.8
1990	-191.5	100.7	-219.5	-23.9	-46.4	226.4	1552.6	81.9
1991	-184.0	98.9	-205.3	-38.8	30.2	213.1	1590.9	74.5
1992	-172.2	98.9	-268.2	-94.4	3.7	215.8	1661.4	73.1
1993	-200.4	98.2	-301.2	-355.7	-46.8	218.2	1678.4	71.1

5.10 TOGO

	FFC_N	PCPI	BCA	BO	GGB	NG	NGDP	TTT
1972	9.1	31.7	-12.9	-6.6	...	7.3	87.6	100.0
1973	7.5	32.9	-10.6	-2.0	...	8.2	90.4	108.1
1974	22.4	37.1	131.8	34.3	...	10.8	130.6	205.8
1975	5.8	43.8	-75.5	10.9	...	19.2	128.3	168.6
1976	12.7	48.8	-27.6	-3.3	...	22.2	136.3	145.4
1977	4.3	59.8	-87.3	-32.2	-39.2	28.6	168.8	136.1
1978	9.9	60.1	-217.4	19.7	-58.8	29.2	189.0	115.1
1979	9.5	64.6	-212.7	-15.6	-17.9	32.3	212.8	108.1
1980	4.7	72.6	-95.0	-32.8	-4.7	35.4	238.4	116.3
1981	32.1	86.9	-44.2	-46.3	-14.8	38.7	258.0	118.6
1982	47.3	96.5	-86.8	-78.2	-4.8	41.8	269.7	108.1

1983	52.2	105.6	-47.9	-38.1	-5.6	48.3	298.0	102.3
1984	68.0	101.8	16.3	-20.8	-7.9	49.4	313.8	107.0
1985	79.2	100.0	-33.5	-3.1	-6.1	44.7	338.2	100.0
1986	63.7	104.1	-65.6	-43.1	-16.6	44.6	365.3	83.7
1987	64.6	104.2	-61.8	-88.0	-25.6	67.7	375.4	89.5
1988	56.5	104.5	-87.6	-31.7	-13.6	67.6	410.7	88.1
1989	78.4	103.2	-53.6	-132.9	-16.2	70.1	431.3	84.1
1990	81.7	104.2	-109.0	-47.3	-13.0	77.0	446.3	90.0
1991	79.3	104.7	-82.9	-60.9	-27.2	71.4	460.8	89.0
1992	83.7	107.2	-59.5	-25.8	-5.0	72.9	487.9	89.3
1993	85.6	107.6	-85.0	-36.9	-44.0	76.6	358.4	85.9

5.11 FRANC ZONE (10 country sample)

	FFC_N	PCPI	BCA	BO	NGDP	TTT
1972	283.2	25.2	-77.9	136.9	1854.5	103.4
1973	278.4	27.5	-266.1	195.2	2072.9	110.8
1974	322.3	31.4	283.0	378.0	2738.3	107.6
1975	259.2	36.7	-795.0	116.0	3123.7	94.1
1976	253.3	40.5	-519.8	126.7	3860.7	119.6
1977	225.2	48.1	-465.5	150.0	4566.8	138.1
1978	189.8	53.2	-1548.2	232.7	4894.6	118.7
1979	120.9	58.7	-1752.0	-66.1	5572.4	113.4
1980	-54.8	65.5	-2446.3	-332.7	6541.0	111.4
1981	-124.0	72.6	-2379.1	-426.5	7667.6	107.8
1982	-221.8	81.3	-2072.6	-431.8	8911.2	105.4
1983	-410.2	89.3	-2006.1	-648.6	9856.2	105.4
1984	-219.8	96.4	-56.6	-501.1	11281.3	108.4
1985	-105.1	100.0	-1014.1	-182.6	12571.2	103.4
1986	-285.3	104.3	-2798.1	-949.0	12764.2	84.8
1987	-542.0	112.1	-2967.1	-2701.5	12262.7	81.3
1988	-667.2	113.7	-3575.1	-3199.0	11842.8	72.3
1989	-644.2	115.8	-2122.6	-2526.4	12117.6	69.0
1990	-437.3	117.2	-2597.9	-2477.5	12079.9	63.6
1991	-382.6	117.6	-2887.4	-2781.9	12067.7	62.8
1992	-415.9	118.6	-3213.7	-3488.3	12061.4	58.8
1993	-438.5	117.7	-2857.7	-3975.8	11586.6	61.4

1. Source: IFS and World Economic Outlook, IMF
and our computation

2. Notations:

FFC_N: Net foreign assets (CFA billions)
PCPI: CPI index (1985=100)
BCA: Current account balance of payments (millions of US dollars)
BO: Overall balance of payments (millions of US dollars)
GGB: General Government balance (CFA billions)
NG: Government final consumption (CFA billions)
NGDP: Nominal GDP (CFA billions)
TTT: Terms of trade index (1985=100)
...: data not available

Table 6: Ratios of current account (CA) and overall balance (OB) of payments with respect to GDP for the Franc Zone

	CA/GDP	OB/GDP
1972	-4.2	7.4
1973	-12.8	9.4
1974	10.3	13.8
1975	-25.5	3.7
1976	-13.5	3.3
1977	-10.2	3.3
1978	-31.6	4.8
1979	-31.4	-1.2
1980	-37.4	-5.1
1981	-31.0	-5.6
1982	-23.3	-4.8
1983	-20.4	-6.6
1984	-0.5	-4.4
1985	-8.1	-1.5
1986	-21.9	-7.4
1987	-24.2	-22.0
1988	-30.2	-27.0
1989	-17.5	-20.8
1990	-21.5	-20.5
1991	-23.9	-23.1
1992	-26.6	-28.9
1993	-24.7	-34.3

Source: IFS and World Economic Outlook, IMF

Table 7: Franc Zone (10 country sample): external trade (millions of dollars, 1985)

	Exports	Imports	External trade	Share in trade among industrial countries
Total	8809.22	6816.71	15625.93	
Industrial countries (IC)	6668.22	4943.38	11611.60	100.00
USA & Canada	1614.68	585.67	2200.35	18.95
Japan & Australia	92.93	322.30	415.23	3.58
France	1831.91	2397.76	4229.67	36.43
Germany	317.70	368.04	685.74	5.91
Italy	517.48	259.89	777.37	6.69
UK	222.51	232.46	454.97	3.92
Other IC	2071.01	777.26	2848.27	24.53

Source: Direction of Trade Statistics, Yearbook 1992 IMF

Table 8: Exchange rate in the Franc Zone
(1972=100)

	nom. eff. rate	effect. real rate (ratio of foreign & domestic CPI in domestic currency)	bilat. real rate (ratio of France and FZ CPI)
1972	100.00	100.00	100.00
1973	95.95	95.83	98.37
1974	94.30	93.92	97.96
1975	90.84	87.11	93.78
1976	98.61	94.26	93.04
1977	98.06	85.33	85.84
1978	93.70	79.20	84.63
1979	93.06	77.60	84.87
1980	100.38	83.15	86.17
1981	113.77	93.00	88.18
1982	124.89	98.03	88.05
1983	142.80	106.15	87.80
1984	151.09	108.28	87.45
1985	134.33	96.77	89.13
1986	125.76	88.54	87.57
1987	118.12	79.61	84.21
1988	126.00	86.38	85.31
1989	120.89	84.48	86.63
1990	116.66	84.48	88.49
1991	116.64	87.67	90.99
1992	117.07	90.06	92.42
1993	121.03	95.11	95.10

Source: IFS and World Economic Outlook, IMF
and our computation (with the use of weights in table 7)